Innovation revolution of smart mobility changeover to autonomous vehicles (AVs)

An Exploration to the role of autonomous public transportation in the form of smart mobility in Nordic municipalities:
A comparative study between Denmark and Norway.

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In memory of my mother

To my Father With love and eternal appreciation

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Abstract

The continuous dramatic increase in the urban population creates many problems related to speedy mobility or conventional accessibility options. However, The rapid evolution of autonomous technology in the field of automotive and information technology (IT) has made it possible to implement autonomous vehicles (AVs) for public passenger transport smart transportation, as a concept, is a contemporary buzzword that should lead to sustainable mobility. In recent years, different Smart transport initiatives serviced globally, which has been supported increasingly by the private and public sectors. Briefly highlights the history and development of autonomous vehicles, and the SAE the 4 phases of AV. This thesis explores the main research question of How these two municipalities aim to integrate AVs (autonomous vehicles) into their public transport systems? The two case strategies had examined where driverless transportation has practiced, in Lørenskogs, Norway, and Aalborg, Denmark demonstrated that autonomy bus passengers are well aligned with the municipalities to reduce the amount of car usage. Ease access for vulnerable groups (young children, physically or mentally disabled individuals and elderly persons). So, the autonomy public transport transportation (PT) can make hard reachable places more accessible, leading to social inclusion. The thesis is primarily qualitative methodology was essential to apply and relies on the work of previous researcher, technical reports, workshops and the empirical data was collected from involvement of stakeholders in the public and private sectors besides the municipalities need to take a leadership position in defining autonomy transportation based on the real city's demand and integrate into sustainable smart transportation planning strategies.

Keywords:
Mobility, Accessibility, Social Inclusion, Smart Transportation, Smart Cities, Autonomous Vehicles, Qualitative Research Methods, Transport justice, Trust.
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List of Abbreviations

AAU: Aalborg University.
Ahus: Akershus University Hospital. ARTS: Automated Road Transport Systems AV: Autonomous Vehicles.
BRT: Bus Rapid Transit
CBD: Central Business District
DARPA: Defense Advanced Research Projects Agency DKK: Danish Krone
DRT: Demand Responsive Transit EU: European Union
FDM: Federation of Danish Motorists
GIS: Geographic Information System
GRT: Group Rapid Transit
ICF: Intelligent Community Forum
ICTs: Information and communication technologies. ICSS: Institute of Communication and Computer Systems
IDA: Danish Society of Engineers
MPM: Morgantown People Mover
NTUA: National Technical University of Athens PRT: Personal Rapid Transit
PT: Public transport
V2I: Vehicle to Infrastructure V2V: Vehicle to Vehicle V2X: Vehicle to everything
VCRT: Vienna Convention on Road Traffic.
VMT: Vehicle Miles Travelled. Vinnova: Sweden’s innovation agency.
K2: Sweden's national center for research and education on public transport.
RISE: Research Institutes of Sweden AB.
TNC: Transportation network companies.
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1. Introduction

1.1 Background of study

Urban mobility is under constant reform in order to facilitate movement and achieve sustainability. With steadily increasing demand for reduced costs, increased flexibility, lower car dependency and redistribution of urban space for the benefit of active transport. Public Transport (PT) is of great importance for this transition; nonetheless, in many cases it features a number of weaknesses, such as limited flexibility, high operational costs and lower efficiency, particularly in sparsely built areas. On the other side, some car-based alternatives like car-sharing and car-pooling can also contribute to the process of making mobility’s more sustainable, by reducing the number of cars on the roads and supplementing public transport (PT), in insufficiently served areas (ceder,2020) . However, it is questionable to which extent expansion of those alternatives will be beneficial for the marathon of making mobility’s smart or will just compete with public transport (PT) and crowd urban centers with more vehicles. There are approximately 40% of the mileage driven in Europe can be covered by independent automobiles by 2030. More than 95 % of the new car sales are anticipated to be partially electrified and 55 % of all brand-new car sales will be completely electrified by 2030 (Berggren,2017). Nowadays, carmakers’ start-ups focus on smart cities because they will be the future for sustainability. Since its introduction, public transport (PT) has required constant reform and continuous transition for achieving higher levels of sustainability. Therefore, the invention of the automobile as a smart mode of transport shaped society in terms of how public commute, how they build cities and infrastructure, where people live and how a new industry is created. Automobiles provide us with a set of advantages, such as considerable freedom of transportation for those who can afford to own the car and helps to maintain sustainable economic growth (Heinrichs, 2015).

However, renegotiation of the role of alternative forms of transport and conceptualisation of new forms should occur. New forms should address challenges that are not being answered by existing transport systems and supplement them to make mobility more holistic, effective, and sustainable. Autonomous Vehicles (AVs) are a forthcoming form of transport and can be an inherent part of future mobility because of their uncountable benefits. Because of their significant economic advantage and, the lack of a driver the constant networking with their surroundings will enable routing optimisation, leading to unforeseen economic and environmental savings (Dennis and Urry, 2009). Therefore, this thesis constitutes an effort to investigate the philosophy of this upcoming form of mobility innovation revolution of a smart transition, by examining its logic and its implementation of the driving forces.
As this introduction has tried to set out, the latest form of innovation of the revolution of smart mobility changeover to autonomy vehicles (AVs) in public transport (PT) viewed as an emergent feature of the currently unfolding transition in urban mobility. However, that offers “an instance of how AVs public transport can become an urban spatial practice promising many new opportunities but also saddled with many intractable problems” (Vestergaard, 2020).

This research seeks to overcome some problems, through case studies conducted in Lørenskog, Norway, and Aalborg, Denmark, an example for new smart and shared mobility services, by analysing the extent to which autonomously public transport in the form shuttle innovation is in alignments or conflicts with the objectives of using of AVs on public roads and serving the locals, by using documents and interviews with experts and representative of both projects. Furthermore, focusing on the use of AVs for public transport as revolutionairy innovation for this case studies, this paper also seeks to respond to a call for sustainability scholars to engage with urban environment agreement s key area for innovation in urban mobility transitions (Wagner, 2015).

1.2 Problem statement

AVs transport as a tool of transition in urban mobility is currently underway and brings with it a variety of innovative transport alternatives. These alternatives are creating disruptions as while attempting to break into the existing transport systems. This is creating both opportunities and challenges for the local authorities.

This thesis seeks to provide a detailed understanding of how well-A shave been applied in the two case studies and how they serve commuters and create transport justice, regulation and governance along with how these groups should be convinced to trust this technology and from the technology point of view assume that AVs will solve one of the problems that social groups face daily for both case studies. It seeks to analyses the alignment and conflicts between the municipalities and stakeholders. Moreover, this thesis will address challenges that are not being answered by the existing mobility systems and supplement them to make transport more realistic, effective, and sustainable. The thesis cannot examine these case studies from all aspects but will consider specific points to facilitate smart mobility because of the limited time and resources.
1.3 Research aim

The aim is to present the possible effects of AVs on cities in a comprehensive manner and outline the corresponding challenges for urban planning, particularly in providing mobility for vulnerable groups in Nordic municipalities, besides showing the dynamics of this new form of urban accessibility. The self-driving bus projects serve as excellent examples of a variety of benefits and contribute to a more sustainable transport system.

The Public transportation (PT) can be considerably benefit from the introduction of smart vehicles to improve safety and sustainability in urban areas, provide a friendly environment, decrease congestion and improve the global service. The social implications of such a huge revolution in technology will change our point of view of transportation systems, thereby increasing the quality of our lives. Automated transport will be safer and more accessible for commuters and will help to create transport justice and social inclusion for those who cannot drive themselves or do not own a car under the upright policy, and vehicle automation will support public transit.

The thesis intend to investigate the role of AVs in the form of buses shuttles in providing smart mobility to solve the challenges faced in the two cases in Norway and Denmark and the effect that they could have on land use, transport justice, and social inclusion, and to determine how to integrate AVs into the transport system to achieve the aims for local society. The exploration of the use of AVs in the two case studies of Norway and Denmark revealed the following next steps

- Firstly, this thesis will present the possible effects of AVs transport as self-driving electric shuttle buses and outline the corresponding challenges of operating in the Norway and Denmark case studies. To do so, the aim is to use qualitative and visual methods.
- Secondly, the different projects that work at revitalising these identified types of AVs are studied. Along with the case study approach, the study aims to suggest strategies applicable in the context of smart mobility and support public transit.
- Finally, the thesis is a necessary action to apply this concept and accommodate options and is carried out as part of in the planning process to accomplish the favored goals to help integrate the AVs as future sustainable transport.

1.4 Research Question

This research is seeking to answer the following research questions:

1- How do these two municipalities aim to integrate autonomous vehicles (AVs) into their public transport systems?

2- How will autonomous vehicles (AVs) create transport justice innovative within the urban mobility transition?
1.5 Previous Studies

According to the previous studies, there are more than 800 cities with over 50,000 residents in Europe. Around 85% of them have a population of between 50,000 to 250,000 inhabitants in the city (Gavanas, 2019). The comprehensive public transport system in the European cities which has been established given that the 1800s; as a result, they are denser and more compressed in contrast with the other cities of the world, which count on the personal car to service their mobility (Muller, P.O. 1995). Studies smart mobility in the form of autonomous transportation (AT) exploring the optimal relationship between service providers and the local governments to achieve the common objective of smart mobility in the case studies. More recently, research by Langeland et al (2021) examine the challenges of the autonomous transportation (AT) to apply this innovation transportation for example creating trust between the commuters, needs more funds and up following technical and planning process. In addition, some studies for urban/suburban areas reveal an apparent dispute amongst group transportation (high occupancy transport) and personal transport, which leads to overcrowding that makes transportation uneasy, prolonged, contaminating, and more costly than required. For example, the high density of European cities is typically accompanied by an excellent preparation of land use, which means shorter daily journeys and more significant public transport shares. However, autonomous transportation (AT) may end up being accessible and enhance mobility options to people that cannot drive conventional transport, such as disabled individuals, the elderly, underage travelers, and people who cannot afford to own a car (Preston, J., & Raje, F. 2007). In the first half of the 20th century, it reveals the worth of time and a constant increase in the ease of access, which results in increased urban sprawl. Furthermore, the revaluation in the innovation related to the idea of "smart" cities helped to make a priority to the contract signed by the EU ministers responsible for metropolitan matters in 2016 concerning urban transport, the arrangement focused on the enhancement of connectivity and gain access to for all. The priorities connect to the prospective benefits of AVs concerning inclusiveness and the ability to reach less accessible areas. Smart mobility research is a field in which autonomous vehicles (AVs) is often neglected (van Wales et al., 2018). The two recent studies, however, have looked at autonomous transportation (AT) as an innovation reflected in within the mobility transition.

1.5.1 The History and development of Autonomy vehicles

Car automation is not at all a recently made progress, as its first envisioning dates back to the externally controlled phantom cars of the 1920’s (theatlantic.com, 2016, engineering.com, 2016). A primitive version of the AV concept was illustrated at the 1939 New York World's Fair, where designer Norman Bel Geddes incorporated them in his exhibit Futurama (Geddes, 1940). Futurama was a visionary concept, which targeted at the facilitation of people and goods movement across the country, enabled by the automated “Magic Motorways” and suburb-based spatial development (Geddes, 1940). Magic Motorways featured trench-like lanes, accompanied by electromagnetic trails,
in order for the vehicles to keep their lanes, while vehicles were embedding railway signaling systems and electronic speed controls (Geddes, 1940).

Serious research on driverless technology began at the 60's (Beiker, 2012) and first projects involving truly self-driving vehicles were conducted for the US Defense Advanced Research Projects Agency (DARPA) by Carnegie Mellon University's (CMU) Navlab and University of Michigan in 1984, as well as by a partnership of Mercedes-Benz and Bundeswehr University Munich in 1987 (Chittilla and Sun, 2017).

First coast-to-coast driverless car trip – “No Hands Across America” - was also implemented by CMU’s Navlab in 1995, where 98.2% of 2,849 miles from Pittsburgh to San Diego were completed autonomously at an average speed of 102.3 km/h (CMU”s website, 2017).

The autonomy vehicle definitions indicate that vehicles can drive from point A to point B in a particular time without interfering with human control (Jerome & Alain L.Kornhauser, 2013). In the last decades, researchers and engineers are looking for the way to how a car drives autonomously. In other words, the self-driving cars projects are divided into 4 phases and continue going to the fifth phase.

Phase 1: function-specific automation" means that human has complete control in the vehicles but concede limited control of specific functions to the Vehicle in certain typical driving situations” (Jerome & Alain L.Kornhauser, 2013: 30)

Phase 2: combined particular functions at least two control functions designed to work in harmony (for example, adaptive cruise control and lane-centering) in certain driving situations (Jerome & Alain L.Kornhauser, 2013: 30).

Phase 3: describes restricted self-driving automation, enabling Vehicle to control all safety functions under certain traffic and environmental conditions. On this level, the driver is still holding the steering wheel and efficient in utilizing the pedals (Jerome & Alain L.Kornhauser, 2013: 30).

Phase 4: The level of self-driving of full self-driving automation happens in level 4, where the Vehicle controls all safety functions and monitors conditions for the entire journey. (Jerome & Alain L.Kornhauser, 2013: 30). In this phase, the driver cant interferes with the vehicle or road safety; the full control will be on the automated system.
1.6 The research layout

The following sections provide background as an introduction. At first, the research aimed to introduce different main approaches. This shows how autonomous transportation (AT) create sharing mobility in the two case studies provide into the strategies of innovation of AVs within the urban mobility transition. In chapter 2, theoretical framework using different theoretical frame from smart city and AVs, transport justice and trust. In chapter 3, using the methodology and methods used in the study are presented and discussed. An explanation of the data used in the study is provided, and limitations are addressed. In chapter 4, using actors and partnership as case studies in Norway and Denmark. In chapter 5 discussion are analyzed using the literature review and case studies strategies. This analysis is divided according to themes identified in the empirical data. In chapter 6, analyzes. Finally, in chapter 7 conclusion and future research, the study concludes with a return to the research questions set out above and presents some reflections on the study and suggests some topics for further research.
2. Theoretical Background

The theoretical discourses in this section are clarified, in the relation to the study, as themes as an analytical framework. Firstly, transport justice was considered in the first theoretical framework since the autonomous vehicles (AVs) concept was introduced as a smart mobility approach and create equity between local societies. One of the main critiques issues is accessibility and social inclusion and the trust between social groups and transit technology in the two case studies of current Nordic municipalities Denmark and Norway. Using the theory of smart mobility and related to the smart cities as technological innovations commonly develop without consideration of the full range of transport justice and trust. This part has been seen from both the concept point of view and the process of planning. Moreover, smart city and AVs have been introduced as a conceptual term, the smart mobility conception and urban vision, and its role in planning are also touched. In relation to the smart city concept as was mentioned before, there is no specific theoretical foundation for this part. Also, using the theory of trust will not focus on how passengers feel about driverless buses without a driver but also their concern about traffic safety. However, it's important to give a view about definitions, dimension and discourse around them.

2.1. AVs and Transport justice

To understand the morality of automated vehicles (AVs), the researcher has to explore the socio-political contexts from the inner-city streets to the urban areas. However, Walzer’s theory ‘Spheres of Justice’ (Walzer, 1995). Tried to use the theory of justice as an approach to transport justice justifying the equality of community distribution. The concept here that the people produce a wide variety of goods to be shared, divided equally, and exchanged in a certain way. In Walzer’s theory, the social meaning related to transport means the local society moves easily to access services and opportunities or to get out of locality and move freely from one place to another.

Due to the public transport sometimes not hundred percent efficient all the time, so AVs could be the answer not reshape the system but to facilitate and avoid difficulty and harm especially to vulnerable groups which will gain a lot for using this alternative and wave the burden which lies on some municipalities in their financial support (subsidies) to sum transportation network companies (TNC) (e.g., Uper and Lyft) in meeting resident mobility needs in the first and last mile (Bhattarai,2016). This investigation examines the possible changes in the society from applying AVs to achieve transport justice.

The Public participation in previewing the AVs introduction is very important to reach transport justice. Working towards justice requires such accessibility this idea applies to those people working on bringing AVs into the mobility system. On the other hand, accessibility leading to transport justice will take into account the changes in the level of accessibility and land use patterns as a main point in
this thesis in the two-case studies Denmark and Norway. Finally, AVs as a toll for easy access to service for vulnerable groups require a broader government intervention such as include service policies measures.

2.2. Accessibility for social inclusion

The need for accessibility is growing fast in our daily life. UN report indicating that the "Convention on the Rights of Persons with Disabilities" was signed with the help of the United Nations in 2007. The Convention's main topics are the attention of "the inherent dignity and worth and the equal and inalienable rights of all participants of the human household as the basis of freedom, justice and peace in the World" (UN, 2006, Art. 1). The central core of the definition suits accessibility – the assurance of specific measures to people with special needs disabilities to access, with the main target to reach social equality (UN, 2006, Art. 9). However, looking deeply into the definition of accessibility is reaching places frequently conveniently and efficiently that would be mixed between two factors: land use and transport system allowing groups or individuals to access their local activities or destinations (Jianquan, C., & Luca, B. 2015.). As this definition refers to accessibility has closely tied up to the ability to move. Such as mobility, and more precisely defined through necessary factors measurements. For example, travel time, distance to a particular destination. The transport development measured with the improvement to the accessibility since the reasonable accessibility control by the spatial distribution of potential destinations, the prober and easy way to reach each destination, the importance, and needs of the activities found there (Gary, El., 2017). There might be a drawback by targeting increase mobility for specific groups or individuals in the community, inadvertently decrease the mobility for other groups which we are not aware of their preferences e.g., by moving bus-stops, changing time-tables) could lead to social exclusion for particular groups(Kenyon & Lyons, 2003).

The term of accessibility-related to social inclusion is access to a place for social interaction, with the most intensive lifestyles of its inhabitants in all its aspects; these locations include retail and comparable central facilities, public services, transport interchanges, open public places, such as square, parks or quays (Lättman et al., 2016.) It is a crucial indicator of the social inclusion of a place, affecting its future development. However, lately, the focus in transport planning has been switched from mobility to accessibility concept (Preston & Rajé, 2007; Qviström, 2015) with trying to widening the scope of focus, but still not including individual or group perspectives. The accessibility crystalized utilizing Hansen (1959) as a way of describing the benefits of a well-planned transport system in a district. By saying that focusing on the difficulties of accessibility for people with special needs is essential, especially in residential areas. In the last decades, cities built up with advanced developing innovation and technology that's led to the increment within mobility services have overseen the social element.
The increasing they have removed from all those assets found the exterior of its space extends. Whether they are old, young, getting to be "second class" citizens, inclining on accessible transportation, which regularly is questionable. (Geurs, 2011) characterize social avoidance as a few bunches of individuals who have avoided a certain level of cooperation in urban exercises in which they wish to participate. As a result of that, can social exclusion led to an increase in social inequalities and centralized transport. For instance: - variety of people experience can face obstacles to reach destination or services, including physical obstacles, cost of transport, or services located in areas very hard to access.

Until these obstacles are evacuated, a high percentage of the populace will stay incapable of moving as they require and, so, their opportunities for social interaction in lifestyle will stay powerless (Mari, 2020). To realize social inclusion, ought to see at a modern Open transport arrangement to decrease the impediments of versatility and availability. However, there is a close relationship between accessibility and social inclusion in connection with public transport. On the other hand, Preston and Rajé (2007) tried to clarify that social inclusion can be accomplished through both the proximity to the activities and services you want (which does not require to support travel costs) and the ability to reach distant destinations within a reasonable time, even if with high transportation costs, or both by an intermediate state between those presented.

The current policy is required for urban mobility and accessibility in metropolitan ranges to reduce the use of private vehicles and increase public transport trust. At the same time, all this is often attainable; it must be guaranteed that the exercises and helpful administrations are effortlessly available by each transport mode. Hence, the planning of public transport frameworks is entirely required a near interaction between the areas of urban openings.

In summary, autonomous vehicles (AVs) in public transportation (PT) ought to provide the ability and equality to everybody for free movement. It is a vital issue for social inclusion policies. one can state the absence of access to transportation (as an essential service) is likewise a huge issue as a significant dimension of group exemption, besides it plays a considerable impact on the other measurements, (Kenyon et al., 2002). Those groups have been affected by more dimensions of social exclusion as limited accessibility to inadequate transportation systems (CTA, 2003).

### 2.3. Smart cities

What the meaning of a smart city? In the last decades, there has been revaluation and growth of information and communication technologies (ICTs) as a result of improved communication technology and software designs. That has applied to many applications in our daily lives and linked to the infrastructure of modern cities. However, the smart cities are often pictured as star groupings of
rebellious over numerous scales associated with different systems and networks that give persistent information regarding the access and movement of citizens and goods in terms of the stream of choices approximately the physical and social shape of the city. For instance, these terms include different factors such as sustainability, technologies, mobility, and accessibility, the term of smart cities beginning to predominate and getting to be involved progressively in our daily lives (Bamwesigye & Hlavackova, 2019). The integration of all smart functions in the smart city will come through merging the information, and data of some purpose will help create productivity, value, equity, and sustainability.

In contrast, a Smart transportation system is an essential element that could transform an ordinary city into a smart city that is accompanied by improving the quality of life. The smart technology will help to make it faster and feasible to accumulate a wide variety of existing information and data, so the development of the smart public transit for different target groups in the society service provider easy access to local services and will help for movement aid (Lee & Trimi, 2018). Hence, sustainable transportation is an aspect of global sustainability, which involves meeting present needs without reducing future generations' ability to meet their needs. Beside the point, smart mobility in a smart city gives all groups in the society there needs through a smart transportation system, and that makes it an essential factor to link all aspects of improvement to everyday life.

2.4. Smart cities and AVs

To make cities inclusive, safe, resilient, and sustainable is one of the goals set out by the United Nations (UN) in their 2030 Sustainable Development Goals (SDGs). Cities are now home to over half the world’s population, and by 2050 it is expected that cities will account for two-thirds of the world’s population (Batty et al., 2012). As cities grow rapidly, so does the demand for mobility and its attendant pressures on the economy, social stability, and the environment. Traffic congestion cost the US economy $124 billion in 2013, projected to increase to $186 billion by 2030 (Harrison et al.,2010). Other growing problems that the transportation industry contributes to are air pollution, climate change, negative effects on public health, and unequal access to services (UN,2015). Especially in Nordic countries, while improving their competitiveness, offering new ways of solving problems linked to poverty, social deprivation, pollution and poor environmental issues (Harrison et al.,2010).

However, cities are also places for diseases mainly because in cities there are high volumes of cars, traffic, and CO2 emission, high cost of living where waste production and pollution are worse. The possible applications of smart vehicles such as connected vehicles (Car2X technologies), autonomous vehicles (AVs) as well as connected and autonomous vehicles (CAVs) are wide-ranging, spanning on a variety of different sectors by the smart cities devices easy to monitor the movement of people going to school, work, libraries, hospital and other community services, goods, traffic information, power
Plants activities, waste management, water supply networks, energy facilities in real-time (McLaren, D., Agyeman, J., 2015).

During the last decade the idea of smart cities and mobility drew the attention of most of the people as a blend of beliefs on how technology in general could be used to transform normal cities around the world into a smart city. The ‘Smart’ cities and mobility can help to alleviate the problems and difficulties of accessibility and mobility challenges by utilizing technological innovation to help different groups of society (Lim, H., S., M., Taeihagh, A. 2018) and reduce the negative impacts of urban development on the environment, economy, and society (Park, J., 2018). However, the infrastructure is one of the most important elements to facilitate the transformation of cities to achieve smart cities. In addition, advanced technology plays an important role in this transformation. There are a variety of challenges related to this transforming e.g., population growth, pollution, congestion and economic development.

In the European cities there are six elements that have been identified and classified as challenges: Governance, Economy, and Mobility. Environment, People and standard of living.

The following schedule shows classification of smart cities challenges and the elements that helped to address and achieve smart cities strategy to be more sustainable. Efficient and high standard of living.

<table>
<thead>
<tr>
<th>Mobility</th>
<th>People</th>
<th>Environment</th>
<th>Economy</th>
<th>Governance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smart mobility</td>
<td>Unemployment</td>
<td>Shirking cities.</td>
<td>Economic decline.</td>
<td>Urban sprawl.</td>
</tr>
<tr>
<td>Urban ecosystem under pressure.</td>
<td>Increased population.</td>
<td></td>
<td></td>
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Table (1), Challenges in European cities. Sources: (Seuwou, Ubakanma, & Banissi, 2020)

2.5. Smart Mobility

The smart mobility system means the integration by the mobility is a system and other systems (e.g., communication and smart technology (Urry, 2010), or it can develop to a different one. It is favored to use the plural, as the focus should give in the interconnections between all types of online and mobility movement of individuals, products, understanding, experiences, and so on (Jensen and Lassen, 2011). However, for the autonomous vehicles (AV) to be consuming as little energy and environmentally
Friendly, it will use electricity as a sort of propulsion (alternative energy) for the move. At the same time, it will incorporate numerous energy-saving technologies and practices, such as low consumption engines, lower weight of the vehicle, and smoother driving.

The seat in driverless pod Navya Arma used in Denmark and Norway include 15-Seat (Holo, 2020). The concept of the autonomous transportation system as a service for mobility and easier access to the destination is in this project addressed as "self-driving mobility and accessibility." Mainly, AV paths will be being formed "just-in-time" according to demand, while smart software will undoubtedly mark the smartest way feasible to implement the journey. Path development will take into consideration the wanted separation and arrival times, the variety of passengers for each course, traffic jams, the total viability of facilities (roadway surface conditions, preference to high-speed bypasses, and ring roadways over dense urban atmospheres, Etc.). During the process, the vehicles and infrastructure and the information and communication technology will be equally important, as mobility is smarter tomorrow than today (Dennis and Urry, 2009; Jensen and Lassen, 2011).

Figure 1. The inter-connection between sustainable transport and smart cities.

Taking the above analysis as a departure point, it is evident that driverless mobility will be much more than a solution for the last mile problem, while their very nature may even put on risk the notion of PT itself. However, the last mile problem will be one of the first and most important challenges driverless mobility and accessibility to services will have to accomplish. The following chapters will focus on the research when and to which level this kind of technology, as well as how it will help the shape of future mobility, to be available for local society as using the theory of transport justice and this
research will also help for creating a bridge between passengers and AVs in other meaning “trust”. In this section researcher will discuss briefly the benefits of autonomy vehicles:

2.5.1 Providing safer streets for vulnerable groups of society

There are about 90% of all road accidents are due to human error (Kyed, a, bet a2017l.), therefore extracting human factor from the equation may bring a corresponding decrease in the number of accidents. Safety gains have already occurred just from the embodiment of ADAS into conventional vehicles. The Demand-Responsive Transit (DRT) is the main transit system, thus the usefulness of the private car (Vestergaard, 2020; Ericksson, 2020). This kind of transport can be operating in the area with low income or with low density as in rural areas, or the car owner of the car is low like in Aalborg East, Denmark, and Lørekjong, Municipality, Norway, as analyzed later. The driverless bus in Astrupstien, Aalborg, Denmark, people can use app applications in their mobile phone, then have their vehicle at their door within 15 minutes or something like that, at least in a small system like this (Venjum, 2020).

AVs may play a dominant role in supplementing and therefore supporting public transports (PT) with better feeder or DRT services, as the lack of sufficient feeders, or the “last mile problem,” is one of the main challenges public transports (PT) faces (Berge, 2019). It should be noticed that efforts to provide alternatives for the last mile problem using conventional (not driverless) modes of transportation have already taken place, but in most cases unsuccessfullly. In particular, high operational costs or insufficient scale economies usually prevented them from being economically sustainable, even if they met demand requirements; in contrast, DRT could also operate for longer routes, for instance, in areas where demand is not high enough to maintain an ordinary fixed bus line. An example of that is the rural area of the Northern Jutland region in Denmark. In this area, it was decided around 20 years ago to shut down rural bus routes due to weak ridership and very low efficiency (Vestergaard, 2020). Instead, NT replaced lost bus routes with “flexure” DRT service, which is conducted by taxis and minibuses. The system works through NT’s app “Rejseplanen” where passenger chooses their departure and destination points, and the app finds the optimum way of making the trip. In case starting and/or ending point are in a rural area that is not served by ordinary PT Rejseplanen includes the use of “fixture” service and calculates the price for the entire journey. Then feeder means (taxi or minibus) is coordinated with the timetables of the arterial bus/train line passenger uses so that waiting time will not exceed 15 minutes, and of course, the passenger will not arrive at the stop later than the main bus/train departs. NT has contracts with around a thousand taxis and minibuses in the entire region, while on an annual basis, 100,000 trips are being made. The system proved to satisfy the demand for rural mobility’s in Northern Jutland in a far more effective way than the previous one, providing both reductions of waiting time for the passengers and significant cost savings for the company.
2.5.2 Channelling the transport pattern in the cities

Autonomous vehicles (AVs) can change the transport pattern in the cities by using shared mobility, which led to reducing the congestion, and improving the quality of the urban environment (Lundestad, 2020; Erickson, 2020; Harding et al., 2014). Some researched and studies indicate that 93% of the amount of car can reduce by using a one fully autonomy vehicle can replace 8 to 14 standard cars and trucks (Alonso-Mora et al., 2016, Rigole, 2014 et al.) also, the AV will be integrated with smart systems such as vehicle to vehicles (V2V) and vehicle to the infrastructure (V2I) - and vehicle to information and communication technology (V2X) use of support will be optimized in many ways. For example, the AV will be more accurate than the human driver therefore that will help to keep the car alongside safety distance. Finally, the introduction of this technology will probably lead to an increase in the speed limit in many cases, first due to the missing out of human fault and second due to the car's enhanced knowledge about the infrastructure and the rest of the traffic (Harding et al., 2014). For instance, in intersections, since the vehicle will be aware of the amount and the speed of crossing vehicles, it will be able either to accelerate in case the available time is sufficient to do so or to slow down earlier to make the trip smoother and save energy.

2.5.3 Policies and regulations for boosting autonomous vehicles in EU

The European Union promotes “sustainable development as a balanced development that meets the needs of the present without compromising future generations' ability to meet their own needs. Sustainable development is based on three pillars, i.e., the social, the economic, and the environmental” (2001).

The European Union's target is to achieve specific targets for sustainable development, especially in the energy sector (Gavanas, 2019). The EU's policy agenda for sustainable development is focused on transport policy, especially the contribution of technology to promote sustainability. The strategy on the Europe 2020 to increase the acknowledgment about the significant impact of urban transport on congestion and emissions (Palacio, 2001). There was agenda name The Transport White Papers of 2001 and 2011 and the highlighted the importance of intelligent transport systems (ITS) and the innovation regarding the autonomy transportation for achievement the sustainable mobility in European cities (European commission, 2011) regarding the urban transport this agreement between EU ministers focuses on the giving the priorities of the connectivity and access for all people. It can be concluded from the European policy agenda for European cities, which means that technology and innovation, specifically AVs, can contribute to this goal.
2.5.4 Value and ethics

AVs will lead to a substantial increase in safety for their passengers and other road users; yet some accidents will still happen (Goodall, 2014). When an accident is foreseen, the reaction of the AVs will not be shaped in situ by the driver, but a priori by a programmer. This raises an amount of ethical and operational concerns. Ethics refers to which practical, moral, etc. Criteria AVs will be based on decision-making in critical situations. These issues have not been defined yet (Vestergaard, 2020, Venjum, 2020, Erickson, 2020), and several dialogues could be expected to proceed when automation technology is safe enough to move - at least parts of - responsibility from the driver to the car (Venjum, 2020).

2.6. Trust in AVs

One of the main issues to encourage passengers to select what kind of transport to travel in common and with buses is trust. However, building the issue of trust between travelers and AVs will help passengers feel safe while moving from point A to point B. The meaning of trust is more critical issues has many dimensions and demands because how travelers feel safe and secure when there is no driver in the bus as driverless AVs (A. Salonen, 2018).

Firstly, the definition of trust is central to interpersonal (Meyer et al.) describe as follow: - it is the willingness of one party to be vulnerable to the actions of another party based on expectations that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party (1995).
As mentioned above the meaning of trust is putting the passengers in the central, in this matter, depends on the AVs taking the passengers from point A to B, if this action can be performed in technology. When the passenger used to ride the driverless buses daily, will help to change his mentality and build trust because he familiar with this product, also the media will play an important role for giving a positive coverage of the smart mobility, it will help the governance, researcher, industrial and stakeholders to adopt this new technology (Wejnert, 2002).

The willingness to adopt new technology, such as automated buses, will change accordingly to how new and how familiar the prospective user is with the product. If the user has been familiarized with a product, through media coverage, if it is positive, it will be more prone to adopt the new technology (Rempel et al., 1985).

### 2.6.1 Build trust of new product

It's very important to become a brand for the new product as AVs buses, research and development of AVs buses must be done alongside with the users. This does not introduce a brand new and unknown technology to the market, which many times is received with scepticism and distrust. However, Trust is developed alongside three pillars: predictability, dependability and faith [Rempel et al, 1985]. To understand the adoption of new technology in general. In the paper, Hengstler et al. argue that the adoption process in early phases is driven by predictability, i.e., how the user can predict coming actions by the technology. Building initial trust is key when introducing a new technology. If there is no trust from the user’s point of view, an adaptation of the technology is very unlikely (Mcknight et al, 2002). If the automated technology can be seen as predictable from a user perspective, the continuous building of trust will be dependability, which can be described as whether the autonomous behavior is perceived as consistent or not. Next step in the relationship is faith, where the user’s trust and relies on technology. However, it is important to distinguish interpersonal trust from human-automation trust. If there is a little trust in the new technology that will little adoption of the rate of the technology.

### 3. Summary

In summary, the theoretical framework focused on different dimensions and distributive perspective on AVs as smart mobility and create transport justice for social groups and to help understand of how the AVs is embedded in society through a variety of interrelated elements. The concept of the smart cities integrated to AVs, utilizing the concepts of connectivity, accessibility and mobility provides a conceptual framework for exploring how Innovation revolution of smart mobility changeover to AVs in Aalborg, Denmark, and Lørenskogs Norway.
4. Methodology and Methods

The methodology and methods used in this research used the document analysis in the research process we can expect advantages and limitations (Bowen, 2009). One of the main advantages that the document would not be exposed to any changes during the research process. Therefore, using the document analytics can be more focused on involuntarily underlying qualitative research approaches such as interviews. Although it’s very important for the researcher to see what is happening in reality to avoid any possible confusion in the decision making, some circumstances could affect this method. Some of the documents can include long term strategy planning. The two case studies exposed in this research include materials, maps, master plan document, zoning restricted by EU transport regulation. These documents contain details explaining their goals, stakeholders, planners and what they needed free of any intervenes or ties from any other possible outsider. For example, this research used the long and short-term planning process to analyze how the document handled and developed and what kind of regulation and policies to be applied in the two cases. Unfortunately, due to the Covid -19 global epidemic normal research method cannot be applied with interviewing face to face. To gather more information and data .The interviews was contact by phone transcribed and by emails instead. The documents consist of two main groups, those about smart transportation and mobility and other documents about policies regulation. Firstly, the researcher try to search and read about main topics related to AVs, smart mobility, accessibility, transport justice theory, trust in technology, policies and regulation. Secondly, highlight the relevant information and cluster them together. Using the concept of AVs and smart cities as the way it is perceived and presented, also, the type of self-drive buses and their area of initiatives were mapped in the two cases. For this part, as data is from both public and private sectors’ resources, this point was also important to see what kind of data developed by which sector and also what is the differences between them regarding language and quality of documents, etc. For the other group of documents- not directly related to the AVs, at the first step, researchers tried to find out what is the how and where the smart mobility in smart cities, strategy, or projects are defined or mentioned in the documents and to see what is the relation of the smart mobility to their strategies. Therefore, in analyzing these documents which are not related to the autonomy transportation, e.g. comprehensive plan for Aalborg, Denmark and Lørenskog, Norway. However, in general, the documents specifically related to AVs, the concern of mobility, and transport justice remain, to analyze how AVs can address this issue.
4.1 Research approach

4.1.1 Case study approach

To address the research questions about the two municipalities, aim to accomplish transport justice for vulnerable groups as one of the main goals for merging the AVs into the public transport system in the two municipalities, there is a need by focusing on these two projects and their goals in adding AVs to the public transport system it improved the mobility in the Scandinavia context. The main object of the case studies is to show that implementing AVs in the public transport system is a smart tool for social inclusion and easy access to services in both case studies.

The two case studies in Denmark and Norway would point out the different ways of using AVs as a form of smart transit in the Nordic municipality. This will help the reader to see the feasibility of the integrated AVs into a public transport system. Hence the qualitative and exploratory form of case study is found to be suitable (Baxter & Jack, 2008). The case studies need to be descriptive and supported by maps and images for the reader's understanding. This helps examine a real-life situation and implement strategies.

4.2. Methods of data collection

In this case study, five interviews were conducted with stakeholders involved; these interviewees regarded essential factors in this case by using semi-structured questioner send by email & by phone because the spread of the epidemic COVID-19 as a mandatory method to cover some essential documents. For instance, the planning process and legislation of applied autonomy transportation in municipalities. However, this Perspective of experts or key stakeholders in a field can provide an invaluable understanding of how processes in this field are structured and evolved. The flexibility of semi-structured questions allows the interviews to unfurl their musings, however much in detail as could be expected, while they build up straightforwardness by empowering specialists to trade their contemplations legitimately with them (Kvale, 2007 p. 13-14).

4.2.1. Document analysis

To answer the two-research question about how these two municipalities aim to integrate AVs into their public transport systems and How AVs can create transport justice for vulnerable groups, it was necessary to employ a combination of methods to build a holistic discussion.

Using the literature review is vital to comprehend the possible benefits and concerns of the autonomy transportation system and to get knowledge about the application of the new form of mobility and accessibility, and how it would be accepted by society and legally. Also, using an empirical-analytical
Viewpoint is among important issues concern in this research since a big part of the proof utilized spouts from details documents in the two chosen cases, where autonomy shuttle bus has been practiced. There is a different documents, files, and reports, including photos and text without the researcher intervention. That includes summaries, reports from institutions, articles, magazine chapters from books, brochures, advertisements, background documents, journals, maps and charts, newspaper press releases, program proposals, study information, Etc. These documents are the primary sources, goals, and methods when development will happen, and advancement is anticipated to occur and become part of future development (Wang & Hofe, 2007). However, most of the planning documents, files, and data information have the Danish and Norwegian versions.

This research using the English translation of the documents is necessary at the beginning place. Nevertheless, the English version has not been provided, but the translation of the document is used. This research aims to see how the autonomy shuttle bus can resolve the difficulties of availability for vulnerable in society from a stakeholder point of view of policy, plan, and methods. However, the previous documents are essential to records the history of planning of the two areas; indeed, the primary objective from document analytics about necessarily the present political recommendation for decision making. This thesis counts on the last version of files for planning, which are mainly preparing for 2011, 2012, 2016, and 2025. It was necessary to employ a combination of methods to build a holistic discussion. To assure that AVs is the proper tool for the smart mobility. Preliminary mapping was conducted along with photo mapping, both methods helped along the way and supported the interviews' and questionnaires' frame.
The list of documents and interview in Tables 2.3 and 4.

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<thead>
<tr>
<th>Title of the document</th>
<th>Type of the documents</th>
<th>Source</th>
<th>Themes</th>
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<tr>
<td>Briefing automated vehicles in the EU 2016.</td>
<td>Brochure</td>
<td>EPRS-European parliamentally research service.</td>
<td>Autonomy vehicles in the EU.</td>
</tr>
<tr>
<td>CO CREATION LAB How can autonomous transport Systems bring value in cities? 2017</td>
<td>Workshop</td>
<td>Drive Sweden - a joint effort by Vinnova (Sweden’s innovation agency), Formas (Swedish research council for sustainable development) and Energimyndigheten (Swedish energy agency).</td>
<td>Autonomous transport and system.</td>
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<td>Title</td>
<td>Type</td>
<td>Organization/Conference</td>
<td>Domain</td>
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<tr>
<td>The Scandinavian way to better public transport. How innovation, devolution and franchising is getting results for passengers and cities.</td>
<td>Report</td>
<td>Urban transport group</td>
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</tr>
<tr>
<td>Safety days Volvo group sustainability (2017).</td>
<td>Presentation</td>
<td>Volvo groups</td>
<td>Sustainable transportation.</td>
</tr>
<tr>
<td>Road vehicles automation in sustainable urban mobility planning (2019).</td>
<td>Report</td>
<td>Project within the strategic innovation programme Drive Sweden - a joint effort by Vinnova (Sweden’s innovation agency), Formas (Swedish research council for sustainable development) and Energimyndigheten (Swedish energy agency).</td>
<td>Smart urban mobility</td>
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<th>Type of documents</th>
<th>Source</th>
<th>Theme category</th>
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<td><a href="http://www.h.2020-avenue-eu">www.h.2020-avenue-eu</a></td>
<td>Urban transport Autonomy in EU.</td>
<td></td>
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<tr>
<td>Information plans for public using shuttle buses in daily operation.</td>
<td><a href="http://www.navyatechnology.com">www.navyatechnology.com</a></td>
<td>Smart transportation in daily operation.</td>
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<td>Title</td>
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<tr>
<td>Some Lessons from the History of Personal Rapid Transit (PRT)</td>
<td><a href="http://faculty.washington.edu/jbs/itrans/history.htm">http://faculty.washington.edu/jbs/itrans/history.htm</a></td>
<td>Personal rapid transit (PRT) and urban mass transit</td>
<td></td>
</tr>
<tr>
<td>Die Bahn will Busse ohne Fahrer Einführen (German Railways Want to Introduce Buses without Drivers)” [In German].</td>
<td><a href="https://www.welt.de/wirtschaft/article160381286/Die-Bahn-will-Busse-ohne-Fahrer-einfuehren.html">https://www.welt.de/wirtschaft/article160381286/Die-Bahn-will-Busse-ohne-Fahrer-einfuehren.html</a></td>
<td>The introduction of shuttles buses in Germany.</td>
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4.2.2 Semi-Structurer interview

Used the qualitative research methods were used to gather information expressed in words as this would help understanding how AVs apply in the two municipalities in Denmark and Norway. This method is suitable for the thesis as it was necessary to know how the Municipality is dealing with AVs in the urban and suburban areas. The professionals would share their experiences of being involved in such projects and their thoughts on strategies of using AVs as smart mobility. Participants involved those who work with the Municipality, architects in the city, professors. Five of the interviewees are working with the Municipality in different departments one from OCWI, two are affiliated with the University, and lastly, an architect. A total of 5 interviews. A list of questions was prepared based on preliminary mapping conducted in the city, and the understanding gathered from the literature review. The questions prepared can be found in Appendix 2. All Six of the interviewees were approached via emails. Some interviewees themselves gave some of the interviewee's contacts. Most of interview was by email using the questioner one by phone was recorded and the last interview were conducted on Zoom due to the pandemic.

Table 4: The List of representatives of interviews

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Organization and authority</th>
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<tbody>
<tr>
<td>Mari Lie Venjum</td>
<td>Specialist innovation department.</td>
<td>Lørenskog municipality Norway.</td>
</tr>
<tr>
<td>Oysten Berge</td>
<td>Project Manager.</td>
<td>COWI (leading occulting group in urban development).</td>
</tr>
<tr>
<td>Jon Ericksson</td>
<td>Project manager.</td>
<td>Kunnskapsbyen Lillestrøm, Norway</td>
</tr>
<tr>
<td>Maria Vestergaard.</td>
<td>M.Sc., PhD Team coordinator SMART Mobility. Department of Mobility.</td>
<td>Aalborg university.</td>
</tr>
<tr>
<td>Dennis Lange.</td>
<td>Senior consultant.</td>
<td>Federation of Danish Motorist, Denmark.</td>
</tr>
</tbody>
</table>

However, interviews took place between April, May, and August 2020, 2021, and the researcher attempt to get information on the planning process, strategies, innovative technological, supportive, or prohibitive policies and challenges establishment of autonomy transportation faced both in Norwegian and Danish municipality. The interviewees were critical stakeholders in a field that can give an
essential comprehension of how planning processes in this field are structured and develop. In Lørenskogs municipality, Norway has chosen specialist state and regional authorities, whose object is related to autonomy transportation mobility's innovation in Lørenskog Municipality and project leader in Lillestrøm Centre of Expertise (Kunnskapsbyen Lillestrøm). In contrast, Denmark, whose object is related to driverless mobility’s, are the Danish Road Directorate (Vejdirektoratet) and the Northern Jutland Transport Authority (NT). Using the interviews is beneficial techniques for recommendation description "recommending descriptions (i.e., the "how is" and "whys") of critical, crucial occasions, as well as insights the reflects of participations relativist point of views" (Bryman, 2008, p. 118) and were used as such here; this approach used throughout the interviews. Using the interview guide used to perform each interview (Appendix A).

The guide of the interview consists of a list of questions and subjects related to autonomy transport in both case studies such as trust, value, regulation, safety, security, parking space, challenges, and spatial planning, however, permit a great deal of freedom for the interview to be performed flexibly (Bryman, 2008). All interview questions send by email. Two of the interviews were recorded through hand-written contemporaneous notes. The interview answers to the concerns were analyzed to determine products that would respond to the research questions.

4.3. Research limitation

This research constraint has been faced like lots of qualitative researchers, and the researcher has been adjusting my research due to the specific challenges positioned by the COVID-19 pandemic. I was on the verge of information collection, talking to when COVID-19 related limitations were enforced. I conducted the research study remotely by doing online interviews by phone and e-mail, getting rid of the observational aspect until social distancing measures were relaxed. The two case research studies style has been selected here for the factors set out above, allied with the desire to provide a suitable level of depth and detail and with time and expenditure restrictions in mind. Of course, other cases may reveal distinctions in the application of driverless transport ease of access for vulnerable groups. Nevertheless, it is not claimed that this research study is straight relative to the writing of accessibility, smart mobility, and sustainability.

4.4. Ethics

In the thesis, the ethics issues have been taken into account during the research. Before starting this thesis, interviews were conducted, and the aim of the thesis was explained in transparency to gain their trust and obtain their honest opinion. Interviewees also informed that they would be sent a copy of the research and interview questions to verify and raise any concerns that they may have, bearing in mind the importance of confidentiality, consent is given, and the opportunity to review the full research
finding. As a researcher, gathering information, documents, and data followed proper investigation rules and transparency regulations.

5. Actors and partnership

This chapter focuses on the key actors and the nature of partnership for both projects in Aalborg, Denmark, and Lørenskog, Norway by consistent in two physical analysis including planning process and the second part analyzing documents and the findings from the interviews both from the public and the private sector. In Aalborg east project, Denmark project has participated with the North Sea Region Transport Forum ART-Forum is a project co-funded by the North Sea Region Program with 16 partners with 6 different countries It regards the impact that automated transport could have on the entire road transport system and life in cities and regions. However, the policymaking powers and uses it as a foundation for decision-making. For example, Sector analyses department Danish Road (Vejdirektoratet), North Jutland transport authority (NT) Holo operates the self-driving service, Aalborg municipality, Aalborg university, also many stakeholders support the project. On the other hand, in the Lørenskog, Norway which will be analyzed as it aims to fill the spaces of public transport (PT) and improve social inclusion in the area by using self-driving buses. 2nd case in Norway refers to utilizing self-buses for ran into healthcare facility location, and 2nd area utilizing for improving the availability for uphill locations. Specifically for vulnerable groups. However, the leading operator of the self-driving buses was French-built Easy Mile EZ driverless electric busses and Acabado Company for the information technology process. Other operators, such as Forus PRT, have performed numerous presentations in numerous locations, one of them Lørenskogs municipality had a demonstration during the European Mobility Week in September 2018, and it was a successful presentation with 435 guests over two.

5.1 Physical analysis

5.1.1 Driverless mobility’s in Lørenskog Municipality, Norway

Lørenskog is a municipality in Akershus. The municipality borders in the north to Skedsmo; in the east Lørenskogs is among the most energetic populations in Norway; the number is about 39,000. In the last decades, the amount of growth has been approx. 3% such as more than 1,000 new residential each year and the number of immigrants increased dramatically about. In the last few years, growth has been approx. 3%, i.e., over 1,000 brand-new residents each year, and the town is diverse in numerous ways and has a high immigrant population about 27% (Jan et al., 2019).
Image (2) Lørenskog municipality area strategy / Regional plan for land and transport in Oslo and Akershus.
5.1.2 Accessible solution for Vulnerable groups in Ahus Hospital.

Ahus is an area in the municipality of Lørenskog in Norway, located at Norbyhagen, about 2 km south of Highway 159 (Strømsveien). Access by car from Oslo or the north will, in most cases, be via E6 to Lørenskog and then highway 159 to Nordbyhagen. Travel time by car from central Oslo is approx. twenty minutes outside rush hour. The Ahus case proposes a self-driving bus solution between the parking garage and the main entrance of the main building at Akershus University Hospital (Ahus). There are two starch one just under 300 meters from the parking garage to the main entrance and the other about 500 meters from the parking garage to the south entrance. It can be a barrier for those who have difficulty walking or are unable to walk, park, or pick up. It probably does not contribute to reduced car use but facilitates better mobility for all social groups. Besides, this case can provide excellent service experience to a large and varied target group.

A large proportion of traffic to Ahus is currently car-based. A TØI report from 2013 showed that approx. 65% of those who responded to the survey drove a car on their last work trip, but around half said they wanted to make more public transport (Easy mile, 2018). Today, there is a large parking lot on the north side of the main building, and there is a big garage parking on the west side of the hospital. The service will attract a diverse group of visitors, hospitalized and working at Ahus, but especially those who use the parking garage. The parking garage has both parking for staff and visitors. The bus will, therefore, transport people from the parking garage to the south entrance. The casing has little climate effect as it probably will not contribute to reducing car use but will help ease the burden of walking, mainly elderly and disabled.

Image (3) Ahus in relation to Rv159 and Lörenskog Sentrum (near Metro center).

The service will attract a diverse group of visitors, hospitalized and working at Ahus, but especially those who use the parking garage. The parking garage has both parking for staff and visitors. The bus will, therefore, transport people from the parking garage to the south entrance. The casing has little climate effect as it probably will not contribute to reduce car use but will help ease the burden of walking mainly elderly and disabled.
One of the main obstacles these buses will operate in is Nordbyhagaveien, where the emergency room located. In case of emergency vehicles running around that area like ambulances and police during an emergency, the self-driving bus reaction should be giving way to these emergency vehicles, but how can the technology solve these obstacles?

The second challenge is there are many vehicles parked on the south side of the main building; that the bus must consider. At the south entrance, the traffic situation can be somewhat chaotic at times, then buses, taxis, and other vehicles should turn around and maneuver. It is not allowed to park there, but in practice, this happens daily. If the vehicle can operate on a pedestrian path, it is an inherent risk of handling it walking, cycling, and others on the footpath. It should not be a hindrance to others the footpath, which probably can be there is a risk that will get emergency sick on board the bus.

5.1.3 Hanaborglia – Grønli area.

Fjellhamar located north of the railway in Lørenskog, above Hanaborg and Fjellhamar train station, is also one of the large residential villas, though also some apartment complexes. Today there is no regular public transport in the residential area, except at the very bottom where the bus runs a short distance along the railway. The population increased in these areas. In Fjellhamar Nord, there are approx. 4100 people and the population have increased dramatically over the last eight years (Jan et al., 2019).
The purpose of the self-driving busses is to attract visitors and residents of Fjellhamar Nord to make use of the train services. In this area, there are no bus connections through the residential area, and some roads have a lot of car traffic. Therefore, it will serve different target groups a self-driving bus route through residential area down to Hanaborg and Fjellhamar train stations. The target group is residents and visitors to Fjellhamar Nord. Notably, the group that uses a car for commuting today can use the train it can organize better. The self-driving buses the goal is to be an alternative for those living in the area and reduce the time of traveling from the train station to the residential area. One of the main challenges there are different contour levels on this route, and according to Google Maps, there are 13 altitude meters up the route towards Fjellhamar, while there are 39 altitude meters back towards Hanaborg. It is a relatively steep hill up from Fjellhamar, which makes walking or cycling less attractive.

This project has been acknowledged by Norwegian authorities as an opportunity to self-driving buses - offering services beyond the current boundaries of the regular buses. (Venjum, 2020), who works in the social innovation department in Lørenskogs municipality, described it as "an example of new technology with private funding that could create real transport benefits for Norway." One of the main obstacles this project explores is the benefits of new mobility technology but did not get to the test phase because of the lack of the fund, and there are little results to show.

One of the research questions was, how municipality aim to integrate the AVs into the transport system the hypothesis was that public AVs could improve mobility for the demographics of local inhabitants with special needs. These could be the elderly or people who have a difficult time moving around. It is an important point, but it is not a huge market. It will not be a game-changer for the mobility sector, at least not for now but there is no vision for include the AVs into the transport system because there is obstacles from technology improvement, needs for funds from public, government and public sector as there is a lack of financial resources for implementation of the entire project (Venjum, 2020). In contrast, it from bigger scale angle and if we can find the proper fund for the AV project that would not only help vulnerable groups, but it would be beneficial for increasing mobility and accessibility for the sack of the urban sprawl especially with the increase in population.
Some studies suggest that personal AVs will increase congestion, and this seems logical. Kari mentions that is why our project focused on AVs in public transport, where several people are using the same service (Venjum, 2020), but the question remains would focus on public transportation improve the situation? That is one reason why operators wanted to start testing.

At the heart of this question, is the use of AV, "AVs could improve mobility for demographics with special needs. Could be the elderly or people who have a difficult time moving around, but it's not a huge market – that's the bottom line" (Venjum, 2020).

Eriksson (2020) refers to the prospect of self-driving schemes making AV unsafe or unusable, for example, for people with disabilities or using pushchairs:” people in society not ready yet for this kind of technology.

Trust is an essential factor that would emerge as a strong influence on the acceptance and use of automated technology. These represent a challenge that is important to solve both politically and in terms of safety, its primary concern as an organization: how the test will go. If we see many upsides, the political push will be more reliable, but there are a bit of limited positive results (Venjum, 2020). However, risk perception and worry for safety and security risks have been found, so; the trust not serviced until the time came to project smart feeder 2017 owned by the Norwegian Railway Administration, in which driverless shuttles have evaluated. The shuttles are intended to provide links to public transit modes. It was available to operate at rush hour times over short distances. However, this project investigated individuals who do not often use public modes of transit regarding the usefulness of driverless shuttles to examine the provision of better access transit. On the other hand, in Oslo municipality, a project consisting of three stages started On May 20th, 2019. The first phase was launched in Akershusstranda area. this shuttle serviced along the harbor. On December 18th, 2019. The second stage was launched at Ormøya Island in Oslo municipality. At Ormøya the shuttles connect the residents and visitors on the islands with the other main public transportation (Berge, 2019). This project makes the area more accessible for people without cars, and most commuters are children who are going from school

Stage 3 started in May 2020 V2X in Kongens Gate the buses helped to communicate with other traffic lights. Therefore, the trust has increased dramatically after the third stage. On the other hand, under legal recognition of AV. In Norway, all traffic regulated by motor vehicle the Road Traffic Act (Act of June 16th, 1965, no. 4 on road traffic). The current regulations allow testing, but only with the driver on board (Lundestad, 2020) for self-driving buses, which regularly run a shorter route with cameras. One must report to the data Inspectorate how personal data is processed. And until the law amended, this regulation will be followed in the test drive.
Mainly, this project has been seen by Norwegian authorities as an opportunity to self-driving buses-sharing services beyond the current boundaries of the regular bus hire scheme. Jon Erickson, Project manager in Lørenskogs municipality, notes that the project tried to explore, but did not get to the test phase we have little results to show for operationally.

5.2 Driverless mobility is in Aalborg municipalities, Denmark

The Aalborg East a self-driving project for making communities and cities more sustainable, inclusive, safe, sustainable, and robust to the fulfillment of the UN's Objective 11. The sub-goal of UN 11.2 states that

"By 2030 access should be produced for everyone to be more safe, accessible and sustainable transport systems are at an affordable cost; traffic security and safety must be improved, name a few things. By expanding public transportation with unique regard to the needs of susceptible populations, ladies, kids, people with specials needs and the senior”

Aalborg town has the most abundant and vibrant suburbs name Aalborg east area. By 1960 the district is divide into numerous locations and according to functionalist concepts that developed traffic effectively, but also physically and socially dramatically divided district most public transport (references, smartbus.dk). The motion of the transportation in suburban areas of Aalborg East proceeds an east-west axis that makes a north-south motion internally in the location impossible with this kind of transport. That is why some mobile population groups can be left out from activities even near their homes and typically become extremely highlighted to a specific degree. For that reason, politically in Aalborg, there was a deep desire to focus on a more sustainable metropolitan improvement in Aalborg East (Vestegaad et al., 2019). Nevertheless, the project aims to serve a considerable part of the district, such as the new university hospital, Bus Rapid Transit system (BRT), the expansion of university campuses, hubs, facilities, and business activities. On the other hand, There are today integrated district pathway approx .6 meters wide in the Astruptien and Jerupstien on a bus and also bike track. Where build a turf verge splits cyclists and pedestrians. In order to suit the buses on Astruptien, the pathway increased from today's approx. 6 meters to a split track were completing 6-10 meters.6 meters to a split track totaling 6-10 meters (Vestegaad et al., 2019).
There are today integrated district pathway approx. 6 meters wide in the Astrupstien and Jerupstien on a bus and also bike track. Where build a turf verge splits cyclists and pedestrians. In order to suit the buses on Astrupstien, the pathway increased from today's approx. 6 meters to a split track were completing 6-10 meters. 6 meters to a split track totaling 6-10 meters (Vestegaad et al., 2019).

This project expands throughout the city administration in Aalborg Municipality. In a step for the Elderly and Disability Administration, the School Administration, public health administration, and the Family and Employment Administration participate in the project. The Center for Mobility and Urban Studies (C-MUS) at Aalborg University. The public-private Innovation Collaborative (OPI) with Holo, which is in charge of technicality, the buses' operation, and the municipality in charge of financially.

5.2.1 Better mobility for social inclusion

One of the main problems Aalborg east faced with was the gab link between northern and southern Aalborg East as well as thus, the Astrupstien passage increased internal mobility and accessibility in the location. The area's different new forms of residential development and renovation will attain
higher communication, and the buses will undoubtedly develop a better link to the location's features. (Greng, 2004). In the Aalborg east area, more than 50% have lower car ownership because of the high unemployment rate in this area. So, many people might have a lack of accessibility to the neighborhood activities. These are elderly, who may take a trip to local markets or bus quits, children going to school or local entertainment facilities, and handicapped, who are going to nearby institutions (Lange, 2020) ultimately, autonomy busses include a big social part within the region. An additional factor of its social part is to boost social consolidation not through superior flexibility yet by getting to be an "icon" of the area. This task's objective is to be a cause of pride for the neighborhood people gaining from the concept of a "first moving" in autonomous transportation. The bus in Aalborg East will not just be connecting components of the issues more smoothly, such as mobility and accessibility, but also will create places identity for Aalborg East suburbs.

5.2.2 The policy plane for sustainable city availability.

The purpose of the sustainable urban accessibility of access plane is to boost living conditions and openness in the city that will help increase by creating conditions for a more balanced modal split. It is about producing a town and a transport system that more individuals, despite age, gender, and socioeconomic background, have access. In a greater sense, it endeavors to facilitate the already begun shift from a commercial economy to a "modern knowledge city with an international viewpoint" (Malmö strategy, 2016). However, the researcher illustrated the graph elements of Aalborg east of
autonomy buses are drawing interior the circle, where’s categorized focus to the area they are more related to, be specific mobility, accessibility, social value, as a symbol of the place and innovation, and eastern to Aalborg district. Also, the self-driving transport measures the performed and way strolling, and cyclists not as it dropped beneath the space of mobility but made sense of honor as a part of the area.

All these components are associated with each other and created the place’s function, identity, and prospects. For example, when the self-driving operated area now is more beneficial as it connected the Aalborg university campus and a new building of Aalborg university hospital, that led to created trust between municipality and citizens rasp more participatory decision-making processes.

Aalborg East driverless bus project is intended to achieve a wide spectrum of goals in enhancing mobility in the area, supporting social inclusion and aiding greater urban regeneration efforts. Being one of the first cases globally and a forerunner in Denmark, along with Vesthimmerland Municipality, in offering regular mobility service with AV comes with many expectations as well as risks. Even if there is no input based on events about this project, some interesting conclusions regarding its design could be the following. First, when innovating, as the world of aviation widely stresses “safety (goes) first”. As previously mentioned, “A post-car system will need to be at least as effective as the current car” (Dennis and Urry, 2009), where term “effective” does not exclude safety. In this case, driverless buses will operate at low speed, run in a corridor with no other forms of motorized traffic and will be light, which may lead to shorter braking distances compared to ordinary vehicles. Contrariwise, coexistence of driverless bus and cyclists may be a kind of challenge, as it will be first time cyclists face this kind of traffic in bike lanes. Nevertheless, considering that involving low speed driverless buses with ordinary traffic will presumably pose remarkable threats, it could be assumed.
Astrupstien is one of the safest environments for driverless technology to be tested. Second, from a law perspective, Aalborg East will also be a “first mover”, along with Vesthimmerland Municipality, but in this field, many questions remain to be answered after related legal framework has been formulated.

Those have to do with modus operandi of the service, safety regulations, liability and ethics in case of an (foreseeable) accident. It should be noticed this is an initial form of the regulatory framework for driverless mobility and refers only to trials of this new technology. Therefore, final law about regular use of AV may address issues in a different way than this law will do. Third remark has to do with the field where the project will take place in Aalborg East. This area could be characterized as a “fertile ground” for the introduction of new forms of mobility due to the physical mobility constraints a part of the population faces and low car ownership rates. In specific, people there will be more willing to try an alternative mobility option, as long as it offers a possibility, which was not available before. This way, advantages of this new technology may be perceived by a greater part of the population as well, while there would be richer feedback by the public on how this innovation should be further developed in order to better meet their needs. Success of this project will substantially enhance mobility in Aalborg East, while it will constitute an important source of knowledge on how to implement driverless mobility, not only on national but also on international scale.
6. Analysis

This is theoretical analytical findings of the case study. Here, the results presented in the previous section are interpreted through the lens of the theoretical concepts set out in part 3. The section is divided according to themes that have emerged through analysis of the results, also it appeared to be much overlapping between these themes.

The two case studies in Aalborg, Denmark, and Lørenskog, Norway demonstrates the ways in which the role of AVs as smart mobility in Nordic municipality and strategies of how integrated it into the transport system for creating transport justice providing the strategies of innovation within the urban mobility transition trust. The actors and institution in these two case studies draw portray showing strong discursive analyses intent to encourage the new tool of mobility for active travel- to the vulnerable groups who live in the outside suburbs to create transport justice, social inclusion and improve conditions for traveling and helps for easy access to the services.

The main perspective in this section is to show how the two case studies is envisioned for the AVs as the form of smart transit as connectivity, how its related to the transport justice and social inclusion. That can be seen in the strategies, visionary approach physical planning process as it has been shown in the preview section of physical analysis, governance and regulations, also public concerns regarding safety and creating a trust for both case studies that can help to achieve local policy goals.

The following part will present the theoretical analytics’ and organize the findings of the thesis according to the methods and theoretical framework.

6.1 Smart mobility for smart cities

Mobility in urban areas is very important for the growth of urban inhabitants. Therefore, the use of smart transportation is an important and efficient part for the public transport system (PTs) to reduce congestion, preserve the environment, reduce CO2 emissions, etc. The smart transit in the form of AVs as a part of smart city want to go further. Furthermore, smart cities are a key player in the digital innovation brought about by advanced technology in the form of digital infrastructure to provide better mobility for vulnerable local inhabitants (Neirotti, 2012; Van Audenhove et al., 2014). However, based on the reviews of documents, and searching for the ‘smart mobility and smart cities’ concepts, different terms were found in relation to AVs projects in the Nordic municipality. In fact, there is a strong relationship between smart mobility and smart cities; therefore, they are often used to convey the same meaning. However, the smart mobility in both the case study projects aimed to develop a comprehensive framework for smart mobility in the form of self-driving buses in urban services, as a technological advancement in this field.
In the Aalborg East project, Denmark AVs used smart mobility to improve the general efficiency, competitiveness, safety, accessibility, and reliability of the current public transport services, particularly for vulnerable groups. However, the use of documents, brochures, and websites to describe smart mobility or ‘sustainable transport’, ‘the transition to autonomous’, and ‘smart energy efficiency’ has always indicated that this mixture of various interpretations in the documents and reports might confuse the readers if they are use sustainable transportation and smart mobility interchangeably. However, one of the main strategies for the Aalborg East project is the introduction of AVs in a shared fleet combined with public transport (PT).

We have a strategy here. We have some big cities in our region, and among these cities, we have a very efficient public transport network between the big cities, consisting of high-speed buses and trains with considerable capacity. People who live in these cities have a variety of PT options. They may also have cars, and thus, mobility is not a problem ((lange, 2020) ). Therefore, the smart transit in the form of AVs will help to shape the future of the Aalborg East project and create a link from the east to the west of Aalborg, expanding new residential areas, finding solution for a number of service problems, and strengthening the local business community. At the same time, the use of society’s limited resources is minimised for the benefit of the environment, the economy, and the citizens.

In Lørenskog, Norway, a feasibility study in the Nordic municipality reported that the use of documents of self-driving buses in city traffic failed to build local support in advance of the launch of these buses and appeared to not adequately account for the local conditions into which the AVs were being inserted (Easy mile, 2018). This was reflected by the fact that the model of Ahus Hospital developed in Oslo underestimated the operation challenges in the Lørenskog municipality.

Moreover, this was frequently observed in both the projects in different two countries in Northern Europe, where smart mobility was introduced by almost only mentioning the projects considered to be smart city projects. Of these two projects of smart mobility, only one project in Lørenskog, Norway, was not introduced and considered to be represent smart mobility because of the lack of integrating AVs into the public transport system.

### 6.2 Strategic planning for transport justice

In both cases, i.e., Lørenskog, Norway, and Alaborg, Denmark, the transport justice was looked at with a strategic approach to how AVs were reliable for vulnerable groups within the main physical urban development areas as an instance of smart mobility. In general, it could be considered an organised vision or strategy for the use of AVs as smart mobility in Norway, as has been reflected in the documents on the feasibility of self-driving in city traffic, among other strategy documents.
Transport justice was not an important point in the interviews for the Lørenskog, Norway, project, and that absence of a holistic view appeared in most of the documents related to the planning process for applying AVs in the transport system to reach transport justice. In fact, every representative interview in the AV transport project had a different perception based on its specific field and this appeared boldly when it came to the city planning department where there was no practical involvement regarding AVs transport and its important roll-out to achieve the transport justice in the considered areas because it was visionary and applied to one area in the municipality and not to the other parts. In contrast, the Oslo municipality, Norway, is a good example of the integration of AVs into its transport system; its strategy offered access to everyone to the transport system. People who did not have easy access to mobility could use taxis paid by the government, and this offer extended to all Norwegians with limited mobility. In areas with a low-density population where people often face transportation problems (Oyaten, 2021), the AV buses will be much better as they will connect these people to various needed areas; for example, train stations can also go from door-to-door services (Mapping and routing efficiency).

For Aalborg, Denmark, the strategy documents show a meaningful linkage to each other, such as a comprehensive plan as a political document such that in these documents, even other related reports are mentioned and visualised in the text as a reference to show the chronology of the policies and the strategies and their conceptual relations. This connection is seen among the visions of urban development, and thus, the intention of following the holistic approach and bigger picture is clear. For example, the vision of the AV plan in Aalborg is a compact city according to which one reason for the development is that Aalborg is among the municipalities in Denmark with the strongest growth. Growth is housing-driven, and a corresponding growth is expected in the years ahead. This was reflected in the Alborg East project transforming into a smarter town. Large parts of the municipality are experiencing high construction activity, new blocks that are rising, and pressure on roads and infrastructure, as the largest development plan is to fill the gap between the east and the west (Widestam, 2018). For example, the vision of creating transport justice is obvious in the Aalborg East project, Denmark, for the vulnerable groups clearly seen in documents and interviews, indicating a meaningful understanding of the holistic approach towards a common goal. In contrast, for Lørenskog, Norway, the strategy documents show that the new mobility plan will cover both long-term and short-term measures; these measures are based on a number of analyses of, e.g., current travel patterns, traffic, public transport, parking, and the vast input from citizens and other stakeholders of Ahus Hospital and the Gronalia area (Venjum, 2020). When it comes to the use of AVs as a smart mobility project, it is seen that this chain is relatively broken, not showing any connection to the urban development strategies or a strong connection to the rest of the main strategy documents from the perspective of transport justice and it focuses more on Ahus Hospital and neglects the Hanborglia–Gronlia area, as there is no fixed public transport in the residential area (Berge, 2021). In this small town in Norway, they want to reduce traffic, they want everything right then road authority and municipality increase car use in a small town it’s very hard to reduce traffic.
In line with the previous point, it was also found that the method of documenting and developing reports for the AV projects in Lørenskog, Norway, was not consistent with the rest and at the same level. In fact, most of them could not be considered political and strategic documents and were almost always developed by private partners, mainly in the form of a presentation and not a formal document. In contrast, for Aalborg, the documents and interviews were focused on developing this project around Denmark, because it was expected to lead to justice, social inclusion, and rebranding of the municipality, making the people feel that they were part of this municipality.

However, it was clear in the case of Aalborg, Denmark, where AVs related to the smart city projects were presented, the language of branding outweighed the other aspects, whose objective was found to be beneficial for both sectors. This also showed consistency with the regional objective of being internationally attractive for this innovation investment (Oyaten, 2021). The last mentioned points about attractiveness were elaborated in the previous section on the physical planning for both the case study projects, where the common goals underlining the strategies of the plans were discussed.

### 6.3 Uniting people through (better) mobility

One of the main reasons for using AVs transport was not just focus on the main physical movement but also create social inclusion. In Aalborg East, Denmark, there is Astupstien, a corridor located in an area with few transport options. This lack of insufficient mobility could lead to restricted access to finding job opportunities, social exclusion, and transport inequality (Grengs, 2004) or restricted opportunity for personal development and recreation. However, in Aalborg East, the rate of car ownership is low, partly because of the high percentage of low-income households and partly because of the large number of people with weaker mobility competencies. Vulnerable groups are the main target, including elderly people who cannot move to the local market area, children with no access to bus stations for going to school or the local recreation facilities, and the disabled, who go to the nearby institutions. Therefore, the AV bus helped to unite the people and helped to enhance social inclusion not only through the integration of AVs into the transport system but also by creating a ‘symbol’ of the area. At the beginning of setting the AVs test in the Astupstien trial, there were where many concerns regarding the bus efficiency, speed, safety, reliability, easy access to narrow roads, and interaction with other objects such as sidewalks, vehicles, cycling lanes, and pedestrians. Furthermore, one of the main goals of this test was how passengers merged with this type of innovative technology and transparency as smart transit. There were many elements of how this innovation could be merged into an area where the local inhabitants feel safe and comfortable while using the buses (Holm, 2017a). The Aalborg East project was ‘the first mover’ in AVs transport, generating a sense of pride and rebranding the municipality as the first municipality using self-driving buses in Europe for regular transport. In addition, the local inhabitants of Aalborg East are multicultural, forming a feeling of
‘ownership’ towards the bus. The municipality with the cooperation of stakeholders created competitions to give the name to the bus, and the use of professional graffiti painting was acceptable.

Therefore, Aalborg East can be imagined as a mystery when AVs are used as smart mobility and a part of the municipality, creating a sense of belonging, pride, rebranding, and feeling of ownership; this helped to solve the entire mystery. The main argument here of whether AVs transport can constitute a means of creating an identity that was not specifically related to Aalborg East or to an area that is under some form of pressure in general.

However, as Holm (2017a) highlighted: I think usually when you give people an option they didn’t have before they are more grateful to take it. It’s no sense in putting this kind of mode in an area where people have very expensive cars. They will say ok even though they are the first movers. Operationally, the Aalborg East project was successful and could be clearly distinguished from a regular public transportation (PT) service, provided by NT. However, a driverless bus line integrated with the existing system by being a part of trip options, offered by the NT’s trip planning app Rejseplanen, as well as by having the same pricing scheme (Vestergaard, 2020). This integrated mobility service offered an even better experience to local people as well as supported the role of public transportation (PT) in the area.

The Lørenskog, Norway, project has been seen by Norwegian authorities as an opportunity to use self-driving buses and shared services beyond the current boundaries of the regular bus hire scheme. Erickson (2020), noted that as the project did not get to the test phase, they had few operational results to show and increasing the use of these buses in the test phase results led to more alternatives for the integration of AVs into the transport system.

In general, the results for the use of AVs and their integration into the transport system services in Aalborg East, Denmark, were beneficial to the local inhabitants of Aalborg East and to the society in general. In contrast, the application of the same system in the Norwegian municipality led to different results according to the differences in the regulations from one municipality to another. It was well planned, but the results were not as expected. One can see the success of applying AVs in the Oslo project, but such an application was less successful in the Lørenskog municipality and might need some more time and improvements in the regulations to adopt AVs completely.
6.4 Regulations and governance

The regulations and the government regulatory work on autonomous vehicles in Denmark and Norway, neighboring countries in northern Europe, were considered. These two countries are similar in terms of culture, as well as the structure of their political systems. They have a long tradition of collaboration, and, in many policy areas, regulation harmonised through Nordic agreements.

The governance in Aalborg was introduced in an effort to help the development of AVs not only in the Aalborg municipality but also in the whole of Denmark, largely because of the shortage in mobility services for local inhabitants of Aalborg East, particularly the immigrants and the people who wanted to reach Aalborg West as an easy way to find a job, merge in the society, and reform the transport system to be more beneficiary. Regulations were set to be introduced, intending to give the local authorities safeguards for the application of self-driving buses.

The Danish governance is a good example of adaptive and seeks to apply AV transport to merge with its transport system. However, an appreciation of AVs in Denmark be feasible by Bill L 120 A of 25.1.2017, which came into effect on 1 July 2017 and was applied as an experiment on the street AV trials. This experiment was scheduled for two years, which extended to five years; during the experiment, the AV trials were conducted on public streets twice (Danish Ministry of Transport, Building and Housing, 2017, translated from Danish). For the perspective of physical planning, the conditions of the trial experiments were configured by the Minister of Transport, Building, and Housing (Bill L realization of driverless motilities in Denmark was made feasible by Bill L 120 A of 25.1.2017, p92). Nevertheless, the AV transport was introduced to help navigate the development of Aalborg East, intended to give local authorities, institutions, companies, etc. safeguards. However, in framing this as asserting the right for the public for participation for vote of using this technology as smart transit (Interview 1) The thought of ensuring the public value and create trust had been as a driving force for applied this project as revolution of industry smart transit (Interview 2), the regulation was succeed and gives optimal results to applied around Denmark municipalities.

The regulation process in Norway was faster than that in Denmark for passing experiments with AVs on the public roads. On 6 January 2016, the Norwegian government authorised the Norwegian Public Roads Administration to investigate and prepare possibilities for regulations that would allow for experiments with self-driving vehicles on public roads, with a deadline of April 2016 (SVV, 2016). Norway, however, went further than Denmark in terms of the role of the driver, as the Norwegian legislation did not impose the requirements of having a driver physically inside or outside the vehicle (TU, 2017).
The main reason that government optimisation into smart mobility spread from city to city was to improve the transport system and make the municipality considerably competent. For example, employees of approximately 50 companies used around a thousand scooters in and around Oslo (Interview 2).

The first experiment on the use of AVs as transport on Oslo public roads was conducted on 20 May 2019; these buses were integrated into the public transport in Oslo in collaboration with Ruters (Berge 2021). Two buses were run in Oslo and another in the outer suburbs, and the buses faced a few obstacles, such as complex traffic environments, many cyclists, and several light-regulated intersections; the people test these buses used the buses not as a ride but to know what they were and how they worked (Interview 2). In contrast, in Lørenskog, Norway, it was difficult to obtain the real impression of the use of AVs as smart mobility around Norway as it depended on how the testing was conducted. If we can see many upsides the political push will be stronger, but as of now, there are a bit limited positive result. Ref. studies that say personal AVs have a little benefit (Interview 3), there are a general positive attitude in this phase, as need more testing, verification and local funds.

The regulations vary from one municipality to another and present a mismatch with the AV transport optimal operating model in Norway. However, the central difference between Denmark and Norway is related to the first factor, adjustment flexibility, and specifically, to how to deal with ‘the driver’ (human or non-human). Norway shows a significantly higher level of adjustment flexibility in its regulation, as it does not require a person to be inside or outside the vehicle. The other three factors point to several similarities. Both countries’ regulations have aspects of flexibility related to context responsiveness in the sense that one experiment can have stricter limitations than another experiment, even though the experiments take place within the same country. Both countries have dealt with the uncertainty factor in similar ways, initiating autonomous vehicles in experiment-based settings. Finally, the governance structure for both countries, through which the regulation interpreted at a local level, poses a significant support from the municipalities, local inhabitants, and stakeholders of Aalborg, Denmark.
7. Conclusion and future research

The objective of this study was to shed light on how AV mobility is shaped, what their modus operandi will be, how AVs can be integrated into a transport system, and how they were implemented in the two case studies conducted in Aalborg, Denmark, and Lørenskog, Norway. The research was dominated by theoretical and technical perspectives. The analysis was also supplemented by interviews from the representatives of the main actors of smart mobility in AV projects and physical planning.

The findings revealed that the full understanding of AVs as smart mobility among the actors in Aalborg, Denmark, was based on the experimental project and applied after a success-based initiative mainly developed by the municipality and the governance. In contrast, in Lørenskog, Norway, there was less contribution from the private sector and lease cooperation between the municipalities, governance, and planners, which monopolised the physical planning. In contrast, the use of transport justice as the main target was less. The AV projects’ strategies and objectives could not act as a strategic vision and concept. This led to an imbalance in the merger regarding local inhabitants excluding from votes the rightness of the process of planning as well lack of funds. Therefore, from this perspective, the citizens were not seen as an integral stakeholder in the planning process but as the follower of strategies and projects.

This research concluded with a return to the research questions set out above, presented some reflections on the study, and suggested some topics for further research. One of the first cases where AVs would perform regular mobility service, Lørenskog, Norway, was investigated in order to identify that autonomous bus passengers are well aligned with the municipalities to reduce the amount of car usage. Easy access for social groups (young children, physically or mentally disabled individuals, and elderly persons), in order to find out about its objectives as well as difficulties its implementation faced.

First part of the conclusions embeds an illustration of autonomy mobility behind the implementation of this new mobility system in two areas in Ahu’s hospital and Hanaborglia – Grønlia area. Then in the second part, duration and aspects of the transition phase towards the fully driverless era is being discussed, according to two scenarios on why the autonomy mobility applied in different areas in Norway and why it’s stopped in Lørenskog municipality. One of the driving forces supporting this form of mobility is that society seems to be willing to experiment with and gain richer knowledge on this technology. Further progress at a regulatory level, which will enable an increase in autonomy mobility applications as well as raise awareness on their modus operandi and usefulness, can pave the road for wider diffusion of this innovation. Review of Aalborg and Lørenskog cases as well as of existing scientific evidence highlighted legal and institutional matters in making driverless mobility, particularly in mixed traffic, as a notable challenge. Liability and ethical
Issues will also influence acceptance and adoption rate of AV, but they are still largely undefined. Study of the Aalborg, Denmark case highlighted safety, proof of usefulness and people’s perception of AV as the most critical factors in the successful implementation of driverless mobility.

Therefore, in order for people to trust AV as a means of mobility and a part of their environment, a particular effort has to be made in order to minimize any safety risk regarding vehicle’s equipment and possible presence of other kinds of traffic. Moreover, AV, should be deployed in services that highlight the possibilities of this technology, such as flexibility, lower operational cost and smart technology by filling in the gaps of the existing mobility system of each area. This is because it will be rather difficult for people to remove human factor from their minds if no particular advantages occur, such as lower fares or less waiting times. On top of that, perception of society towards driverless mobility will largely affect their realization and diffusion, hence their modus operandi and benefits should be extensively communicated. At the same time AV should embody no less qualities than ordinary cars (modernity, comfort, entertainment equipment etc.) but even fill their gaps, e.g. by replacing philosophy of sedentary with a sense of community. An outcome of the case examination is that initiatives where shared AV are rolled out onto the streets can greatly strengthen the sense of community in the area, as Citizens may treat these projects as communal ownership. Therefore, extensive communication of this advantage may generate interest from public authorities/companies/universities etc. to introduce or test driverless mobility at smaller (inside campuses) or larger (for the last mile problem) scale. Analysis also showed that fully unmanned operation is less of a challenge in gaining acceptance of driverless mobility, as it is becoming increasingly evident that onboard operators perform more a psychological than an actual role. The self–driving shuttles is part of a new wave of smart mobility services aiming to transform the way people move around cities and create a new way of mobility technology more accessible to more vulnerable people and offers cities an opportunity to achieve sustainability, social inclusion, and environmental goals in Norway and Denmark. However, there have been some difficulties that are troublesome for the stakeholders. This way, these stakeholders have tried to limit and manage to guide the course this new type of mobility will take and reassert dependability in the vehicle framework.
Finally, returning briefly to the research questions set out at the beginning of this thesis, the following can be stated:

1-How do these two municipalities aim to integrate autonomous vehicles (AVs) into their public transport systems?

Lørenskog, Norway, is an example of a visionary focused on physical planning and not on creating transport justice. The municipality is digressing from the main objective of the project to serve vulnerable groups. For example, the existing documents and interviews have revealed that AVs can be made more accessible, particularly by bringing autonomous shuttles to the difficult-to-accessible or inaccessible parts of the city, such as Ahus and Grangold. Here, the main challenges are a lack of funds, slow development of technology, and a lack of public trust. Furthermore, AVs can be used as sources of big data for urban planners and designers. However, the implementation of self-driving bus schemes has conflicted with the public authorities’ need to ensure that public space is safe and accessible for all users. AVs have been viewed as vehicles adding street clutter to limited shared spaces and have thus been a source of friction between both city users and the public and private sector actors. In contrast, Oslo has ambitious environmental targets and has been appointed as European Green Capital of 2019. In sustainable development, mobility plays an important role. Oslo has set a target of reducing car use by one third by 2030. It is in fact politically significant that shared transportation with a high level of service be sufficient to reach the traffic reduction targets in the Oslo region, solve the problem of road capacity, and make the area more accessible for people without cars or for those living away from the city center. For instance, it should help its regular customers such as young children to travel to and from school every day.

The AVs bus-shuttles in both case studies objectives encourage using new mobility technology as active travel and help to solve the challenge of access for local services that can facilitate this for more vulnerable groups, especially for (young children, physically or mentally disabled individuals and elderly persons).and create transport justice social inclusion for local inhabitants.
In the case of Lørenskog, Norway this is an example of focus visionary for physical planning not for other sides like creating transport justice overall the municipality and losing the main objective of the project to serve the vulnerable groups. For example, in the documents and from interviews analyses that shows it is viewed as having the potential to make AVs more accessible, particularly by bringing autonomy shuttles to parts of the Lørenskogs, Norway that does not currently have both areas Ahus and Grangold; the main challenges lack funds, needs more development technology and lack of trust from participation. Furthermore, it has the potential to use AVs as sources of big data for urban planners and designers. However, the implementation of self-driving buses schemes has conflicted with the public authorities’ need to ensure public space is safe and accessible for all users. AVs has been viewed as adding street clutter to limited shared spaces and has thus been a source of friction, between both city users and public and private sector actors. In contrast, Oslo has ambitious environmental targets and has been appointed European Green Capital of 2019. In sustainable development, mobility plays an important role. Oslo has set a target of reducing car use by one third by 2030. There was politically significant that shared transportation with a high level of service will be sufficient to reach the traffic reduction targets in the Oslo region and will face the challenge road capacity and it makes the area more accessible for people without cars or living out the city center that create, and helped to create “regular customers” children’s who being driven to and from schools every day.

The case of Lørenskog, Norway has illustrated several ways in which AVs as self-driving require practices that are not easily incorporated into the existing physical urban design, thus creating conflict and friction, which has acted to stifle its momentum. This has contributed to the technology only receiving partial, geographically limited support from public authorities, compounded by Norwegian authority, a structure that has not proved a supportive self-driving operating model.

In contrast, Aalborg It will be rather unexpected that everybody will be able to access high congestion corridors or areas, like city centers, on a small pod, even if this is shared with three or four more people. Contrariwise, in areas where congestion is low, it could be assumed there will be no reason to keep medium-sized buses, whose occupancy rates will not even be satisfied when there is enough road capacity for a dense network of DRT. On this basis, the two cases which could be the examined objects in the future research projects are as follows.

Firstly, it would be interesting to examine the contribution of neighborhood-scale AV routes in spatial and social cohesion in the served area. This example could refer to the case of Aalborg East, where AV will connect various parts of the neighborhood with the local center and other facilities. In such a case many issues could be researched, to mention a few ex-ante and ex-post acceptance of the new mode; the extent new mode enhanced attractiveness of local centers/facilities to local people; and contribution of new mode to social cohesion.
Secondly, it could be worth examining the criteria for characterizing an area as "fertile ground" for introducing driverless mobility. For instance, in the case of Norway, one of those conditions is the existence of people who might be not so mobile; hence driverless mobility will provide them with a possibility they did not have before. It is posited that self-driving buses will help achieve its potential to expand the reach sharing in both case studies, more significant support for future research.

Finally, it can be clear in the case studies where AVs related to smart cities projects are presented, the language of branding outweighs the other aspects especially in Aalborg, Denmark the ambition which was found beneficial for both sectors. This also shows consistency with the regional objective of being internationally attractive for this innovation investment. The last given points about attractiveness are elaborated in the previous section in the physical planning for both studies projects where the common goals underline the strategies of plans are discussed.

2-How will autonomous vehicles (AVs) create transport justice through innovative strategies within the urban mobility transition?

The transition to autonomous transport and the consequent redesign of the built environment will be determined by several interconnected factors. Social attitudes, for instance, will influence the extent to which a given population will adopt autonomous cars, as well as the modes whereby this new transport technology will be used.

The two case studies illustrated several ways in which AVs could lead to justice and equality for the local society. The Aalborg East case helped to convert the community from segregation and exclusion to social inclusion and linked east Aalborg with west Aalborg to unify the city center. In contrast, Lorenskog, Norway, struggled to incorporate AVs easily into an existing socio-technical configuration. In particular, the introduction of early versions of the innovation failed to collaborate and build local legitimacy to local conditions, resulting in freezing the project in its early momentum; this contributed to transport injustice in the area. People living in Lorenskog and its suburbs lost the support from public authorities for this project’s operating model.

The societal and environmental impact of AVs will depend on whether they are used for private or collective purposes. While AVs promise to bring environmental, safety-related, and economic benefits, as well as increase accessibility to mobility services, there exist potential adverse effects from mobility becoming more accessible.
Addressing these issues hinges not only on policy decisions that incentivize sustainable mobility behaviors but also on identifying factors that represent challenges to the adoption of AVs in each region, as well as on adopting appropriate business models. Therefore, this multidisciplinary study provided insights into citizen opinions and a business model analysis together with policy recommendations, with the goal of helping foster a timely adoption of AVs that would also generate a positive societal impact focused on the use case of autonomous shuttle services complementing public transport for the last mile as a long-term planning strategy to serve all society members as future transitions.

The contribution of the present study is multifold. First, the study extended the extant literature and aimed at bringing clarity to the contended effects of the factors affecting the adoption of AVs providing an understanding of the local public attitudes regarding autonomous shuttles among inhabitants and commuters. Second, it took a comprehensive approach: following a review of both the potential advantages and disadvantages of AVs and of the challenges to adoption and was complemented by expert interviews with a diverse set of relevant stakeholders. Third, it aimed to provide applicable, practical recommendations at the local level, with the aim of ensuring the adoption of the technology in the specific, studied local context, according to its mobility and policy needs.

Autonomous shuttles can improve the existing transit services by making it cost-efficient to increase the frequency and accessibility of public transport at night or in less densely populated areas. However, for AVs to improve traffic efficiency around urban areas, it is paramount to avoid the substitution of public transport by alternative mobility behaviors relying on single-occupant trips. This requires making public transport more affordable and available, hence more attractive to the end-users. However, the aim of this thesis was to add to the knowledge in the field of urban studies by covering the AVs’ perspective, creating transport justice for social groups, building the trust between the local community and technology, and adding to the insight into the challenges created by spreading out the smart urban mobility transition and providing easy access to destinations. This thesis considered the analyses of documentary evidence and insights from the stakeholders integrally involved in the case. With multiple stakeholders providing alternative points of view. hope that the study of these two-cases has met the research aim.
References


Forschung & Beratung GmbH. Road Vehicles automation in sustainable urban mobility planning, 2019.


Park,J.:Sense making,(2018),What Will Autonomous Vehicles Mean for Sustainability?.


Appendix

Interview dates


Websites


Interview transcripts

Jon Ericksson, Project Manager in Kunnskapsbyen Lillestrøm, Norway

1- First of all, would you like to tell me something about your involvement, in the Ahus and Fjellhamar in Lørenskog Kommun driverless bus project and with driverless buses in general?

I worked as a project manager for the Autobus project. This was an Interreg-project that we had together with Lørenskog kommune, RISE, Borås Stad.

2- You also have a study about that; how do you thing this problem - increase in congestion by AV - can be alleviated?

I'm not sure I understand the question completely. I interpret the questions as, how AVs can increase congestion? First of all, we do not fully understand how AVs will impact society and the transport sector in general. Some studies suggest that personal AVs will increase congestion, and this seems logical. That is why our project focused on AVs in public transport, where there are several people using the same service. The question still remains if this will indeed improve the situation. That is one reason why we wanted to start testing. Aalborg social sustain

3- Do you think shared cars can replace public buses?

Probably not, but it depends on how you define shared cars and how they will be used. I think it's still much more efficient to transport a large number of people together than in smaller metal boxes. But, the higher degree of sharing for shared cars can alleviate this problem to some extent. Cars take up more space.

4- What about the legislative framework for AVs? Is it ready? Are there any preparations being made at the moment?

Norway has made some headway and is allowing testing under certain conditions. It is definitely not ready, but we have taken the first important steps. (I have not followed legislation in the last year or so).

5- Could you state some of the important ethical and liability issues regarding AV?

There are many issues here and is a field that needs to be developed. The question still remains who holds the responsibility in case on an incident. Is it the software owner, hardware owner, the operator of the vehicle, the owner of the vehicle? It may to some extent depend on what actually causes the incident. But this question is more suited for a lawyer.

6- What about the implementation of autonomous mobility’s politically? Which powers in the society will support them and which will oppose them?

It's a bit hard to say and depends on how testing will go. If we see many upsides the political push will be stronger, but as of now there are a bit limited positive results. Ref. studies that say personal AVs have little benefit.

7- How about the political willingness so far to implement AV and which are your thoughts about those decisions – the political stuff?

I think it has been a bit of both. I think there is a general positive attitude in this phase, as we need testing and verification.

8- How might autonomous vehicles (AV) alter the quality and quantity of access that different social groups have to physical mobility?
This is one of the interesting points that our project tried to explore, but as we didn’t get to the test phase we have little results to show for. The hypothesis was that public AVs could improve mobility for demographics with special needs. This could be the elderly or people who have a difficult time to move around. It's an important focus, but it's not a huge market and will not be a game changer for the mobility sector, at least not for now.

9- How these tools can or have had improved accessibility?

I think it may increase accessibility.

10- Who are the excluded persons in the cities?

Not sure I understand the question. My idea has been that this should be for everybody. Unless its specialized transport for certain groups such as elderly or disabled, but then I don’t think exclusion is a problem. (Planning process) land uses face their own challenge due to the implementation of AVs. Also, the challenges for urban planning is particularly relevant to Europe, where urban areas account for 70% of the population (with an estimation of an increase to 80% by 2050), 80% of the energy consumption and 85% of the gross domestic product (GDP).

11- Which kinds of technologies, information, Data, apps entitlements as kinds of support transportation for less accessibility persons?

I don’t understand this question. Sorry. 12- How about the society, is it ready? No, it’s definitely not.

13- Do you think that in places that where AV projects will be developed, like Ahus and Fjellhamar in Lorenskog kommune these projects will rebrand these areas as innovative, open minded or efficient?

I think it would have some impact to that effect, yes. If anything only for a while.

14- How might the development of autonomous cars (Autonomous transportation) reflect the values and preferences of specific groups of people?

Not sure I quite understand the question completely. I’m not sure that values and preferences will drive the development to a large extent in the early phases, because the tech is unknown and has limitations. If we get past a certain point where we see and experience significant benefits, there may be some push.

15- How might autonomous vehicles alter the quality and quantity of access that different social groups have to physical mobility?

It may make it easier to move around. In theory we thought that transport could be more frequent and tailored.

16- How might autonomous vehicles intensify different axes of social inequality?

Depends on what kinds of AVs we are talking about. I think it should be public and for all, and it needs to be shared. Like buses or similar. If we move in the direction of personal AV Teslas, we may contribute to some inequality.

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<thead>
<tr>
<th>Topic area</th>
<th>Guiding Interview</th>
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<tbody>
<tr>
<td>The role as project manager in urban development of COWI.</td>
<td>In this project we developed a traffic model for autonomous cars to investigate the future scenario for urban mobility in the Oslo region.</td>
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<tr>
<td>The obstacles that has faced the project in the Oslo region.</td>
<td>In the city center there is a lack of measures security as the AVs buses don’t adapt with cycling and cars in the traffic.</td>
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<td>The political willingness of implement this project.</td>
<td>The government optimizing into future mobility in Norway that’s vary from city to the city as every municipality has own regulation and a lot of competences.</td>
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<td>Creating trust for using the AVs buses.</td>
<td>The local inhabitant they have a curiosity about the smart transit and how its work but they prefer driver to monitor the bus if it case out of control that create sense of safety.</td>
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<td>Transport justice.</td>
<td>The AVs buses in Oslo helped to solve the problems of transit especially who living in the suburban areas for vulnerable groups, especially elderly, disabled and children who going to the school. As we intend to corporate in small towns for applies AVs to reduce car usage and create transit services from door to door.</td>
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Mari Lie Venjum, Specialist innovation, Lørenskog Municipality, Norway.

1- Why should we implement driverless mobility’s?

I think the clearest answer is a quite stupid one. It’s due to their benefits. If you look at the enormous investments of car manufacturers and software companies, it seems that a lot of people out there can see substantial benefits for consumers; otherwise they wouldn’t invest so much in this technology. There might be something, as they think this is the key to win market shares in the future. So the reason they are spending that much – and employing a lot of engineers by the way – is that they may think this is the only way that they can have a future. And of course there will be some contradictions to this. For example Toyota says we are not much into this; there is also Alfa Romeo who says we will never be engaged into this, because the joy of driving is the main reason why people buy an Alfa Romeo, but of course they should do this, otherwise their share values will fall. Still, apart from them all the others are heavily investing in this technology.

2- Which are your concerns and challenges that will mixed traffic face?

That is a hard question. It will be for sure harder to introduce these cars as long as there is mixed traffic. That would be an additional problem. I think something like autonomous driving will only be
possible in an environment where all traffic is autonomous. Because there are some other benefits (e.g. driving in shorter distances) and I think you'll never get the full benefits of autonomous vehicles as long as there are ordinary vehicles out there. For example, some highways have two lanes now but in the future you could easily have them with three lanes in the same place. But you have to have a full implementation of AV to see these benefits. So there are some of these benefits from AV that will not be seen until the last manual car is over. We are already speculating because there are some unknown elements in this equation. Because how will the politicians make it? Will they make dedicated lanes? I don't think they will but I don't know. Will at some point say you can't go on a highway if you drive a manual car? We don't know. It's possible when we reach maybe 95% penetration of AV that it will be optimal to make it [ban ordinary cars from highways]. It's really not on me to say what politicians will do when we get to that point. Cost for travelling by train is 23% lower than driving a car. Then I say ok, in a train you can do more things like reading a book or even go to the toilet. You can't do that in a (level 3) driverless car. So I just make a plain assumption that maybe cost is not as lower to driving an ordinary car as travelling by train; maybe it's just half of it. However this is just an assumption; you can't do any calculations on that. That is because actually we have no studies in the world saying something about it. One thing we know from socioeconomic analysis is that for every accident with personal injury or death where a four-wheel car is involved there is an average cost to society of 5,4 mil NOK. What I'm saying is that you have a possibility to introduce these cars and the benefits are real. So of course we have to be aware of the fact that there could be problems in the process and or sure we should not close our eyes that there are those technical issues and ethical issues and so on, but we should also embrace the benefits. If we just say I will not work on this technology there will be a cost. The cost will be in lost benefits. Maybe it will not be a part of national accounting system, not in GDP but it will be real. And then there are a lot of things that I haven't included. I haven't included that you can optimize driving with fewer accelerations and fewer braking. This also means some environmental and positive fuel effects; road capacity savings. There's the potential to increase the speed limit and that's because when the probability to get involved into an accident decreases then the optimal car speed increases. What you want to do is to get from point A to B as fast as you want. But there is a condition; you don't want to kill everybody on your way there. So what you have is actually a balance of these two things. That you don't want to get anybody killed but you want to get there right away. So what happens is that when the probability to get injured decreases then the optimal speed limit increases. Again it's a speculation, because this is a political decision. But from an economist's point of view I would say it would be natural that if we see a decrease in accidents we should actually be allowed to drive faster. There are also other things, there are some restrictions on truck drivers; that they have to rest and there are some limits on how long they can drive; there are some regulations on that. Maybe it's not necessary to have these regulations. So there will be like a truck platooning so maybe you could save 2/3 of truck drivers. This is about some of the benefits of going from level three to level five. I haven't done any calculations on this but this is just to get a feeling that what we see now would not be optimal in a level five world. This is a pretty normal car in Norway [showing a conventional private car], but if you look at it it's far from optimal in a level 5 environment. So what we have here? We have a single owner car, so there are a lot of consumers who have a lot of their savings actually tied up to a car for maintenance etc. So there’s some cost that can be saved. If you also look at the traffic and the commuters, often there is only one person in the car. This car, even though it is used for commuting every day by a lot of people, it is actually built for a weekend, for a holiday situation. It is built in order to have the whole family, your skiing equipment etc. It's not built for that situation [commuting]; It's really not efficient. How much time of this car's use time will be the situations where it's necessary to have it? Not much. So it's not optimal. It's quite heavy and this is because it's built to cope with an environment where there's a high chance to collide. But what if the probability of getting into an injury decreases dramatically? Then it's maybe not optimal to have such a heavy and rigid frame. Then there's a whole issue of how much time you use this car. A study says it's about 4% of car's lifetime that it's actually used. So there's a huge potential of using the car more instead of having them parked down here. And the last part is that you have a car where you have to have a driving license. Not everybody has one, (like children, elderly people). So maybe we see something like this [showing a level five car]. What we see is (I don’t put money on this but just to illustrate what we're talking about); in level 5 you can actually read the newspaper. Maybe you can play with your kids on the back seat and so all sorts of things. So the cost of driving drops even more. Level 5 situation will of course influence where people want to live. It's not super clear in which way it will go. There are some who say that the cost of driving will decrease, so it will be less costly to live hundreds of kilometers away from work and commute to there. So maybe we'll have a more dispersed
population. But there are others who say it will not be like this. (...) They say it will be even more attractive to live in the city center because congestion will increase. And congestion will increase because traffic will increase. So which one is true maybe it’s the second.

3- How about the political willingness so far to implement AV and which are your thoughts about those decisions – the political stuff?

I think so far there has been a quite positive attitude towards this area. Both the former and maybe especially the new minister of transport have embraced it and stated clearly and loudly that this is the future and we have to get ready for it. There will be trials. The legislation that says you are allowed to make trials, like in Oslo and elsewhere will be there in July. So they will test it and that's a good sign. What I fear a bit is when we'll see the first kind of accidents how politicians will react. Because there's a danger maybe that they will overreact. If we have a car accident where an AV driving over a little girl or something I don't know how the politicians will react; I'm not sure about that. I think that there's a real chance that they will be overreacting and kind of - maybe not putting a stop but - putting a delay in their implementation. But again, I’m just speculating.

4- How about the society, is it ready?

I don't know and I think probably there will be some adjustments in people's view of it. I think the first experience we have with one of these cars will make us more familiar with that. And maybe it will be a provoking the first time or just letting the car drive by itself, but hey, we have metro where there is no driver either. So there's a lot to get used to it. Maybe these people will have a hard time in the future because maybe they will not be able to enjoy their car. Then there is another big issue. How will the insurance market be a part of it? If for instance you can get that if you drive an AV you are not responsible for almost all accidents? If that will be the case, then the insurance premium on ordinary cars will increase substantially. Because if something happens it will probably be the fault of the manual car or of the driver of the manual car. So, who covers the cost? Maybe the guy in the manual car. So maybe it will be a big gift, coming from insurance companies, but I don't know. That could be a scenario. Because some people say we'll always have manual cars.

5- Do you think that in places that where AV projects will be developed, like Oslo, these project will rebrand these areas as innovative, open minded or efficient?

I don't think you'll attract car industry just because you make a trial with an autonomous bus. One thing you should maybe have an eye on is that these small factories, which cut down the design phase, I think from 8 years to like 1 year – which is crazy - maybe could actually result in making Norway again the car manufacturing country. I don't know how big chance there will be for this, because we have Germany just in our backyard and Germany has well developed car business. Maybe there is a chance, I don't know. And of course it will be interesting for some of these [AV manufacturing] companies to collect some data on what is working and what is not working. But why should you want to place a car factory [at the test field] at a moment where this data can be sent to whatever part of the world.

I could maybe overlook something; I don't know. But I had a hard time seeing from a business point of view what is the case just because somebody says “you can try here”. Then all places which are trying this technology should have this factory. I think they don't have. So maybe that is the wrong reason to try this technology in my view. There are a lot of good reasons finding out which are the prospects of this technology also for the municipalities. You can make transport of disabled people more efficient, you can save bus driver's salary in regular routes and so on.

6- What obstacles have you faced in both projects (Ahus and Gronlieg area) in Lorenskog Kommun?
Firstly, lack of funds for both projects as an experiment for test drive cost about 2 million NOK, and we try discussed with Interreg öresund-kattegat-skagerrak EU fund organization to complete these essential projects. For example, Ahus Hospital, one of the main planning challenges we face of driving on a stretch with emergency vehicles. For example, Other road users / obstacles (motorists, pedestrians, cyclists, buses, trains). Intersections and crossings (traffic lights, intersections, pedestrian crossings) and Vandalism / vandalism (type of area)

There are several issues with the case for Ahus.

7- Is there a disposition to drive the vehicle on a footpath? • How well does the vehicle operate with many pedestrians?

Driving on Nordbyhagaveien, where the emergency room is located. It is unclear how the bus operates in relation to ambulances and police on call. This is a risk that can be turned into a potential development opportunity for the technology. Can you make the vehicle stop and turn as far as it can to the side when there is expression? Any testing here must be carefully considered. The question is whether a self-driving bus is a bigger obstacle than a normal road user for an emergency vehicle.

On the south side of the main building, there are many vehicles parked that the bus must take into account. At the southern entrance, the traffic situation can at times be somewhat chaotic, as buses, taxis and other vehicles have to turn around and maneuver. Basically, it is not legal to park there, but in practice this happens daily.

If the vehicle can be operated on a footpath, there is a natural risk how it interacts with pedestrians, cyclists and others on the footpath. It should not be an obstacle for others on the footpath, which it probably can be. There is a risk of getting acutely ill on board the bus. This must be handled in a good way. In Contrast, Hanaborglia – Gronlia area can be a slippery road. It's very hard for cycling and walking because it's up and downhill, but when you compare to Ahus, it has a low risk, as you drive on relatively low-traffic sections with little challenging road structure. Also, the race will be around 2.6 km long, but few will be interested in driving on the entire route, as the goal is the train station and housing. The number of stops is challenging to estimate, but it will not be appropriate to have stopped too close to each other. These will be adjusted in consultation with the operator before testing. Also, it can be interesting to see if the bus can be ordered to dedicated areas and whether the bus itself can detect that it is full or not so that it can stop or continue driving.

Dennis Lange, Senior consultant, Federation of Danish Motor is Federation of Danish Motorist.

1- Why should we implement driverless mobility’s?

There are several reasons why we should do that. First of all because they're going to increase mobility in our society; we will have the possibility for better use of travel time, to have more traffic in a sense we will have more cars at a time on a strip, on a road. And then we will have an impact on safety because for many reasons they will reduce traffic accidents. They will also make goods, labor, and services and so on to become mobile more easily than today. Therefore it will be a good thing for society to get AV. However they are not necessarily going to solve the problem of congestion, as AV are going to attract those who are now not able to drive.

2- You also have a study about that; how do you thing this problem - increase in congestion by AV - can be alleviated?

There could be a kind of equilibrium. It can be that at some point there will be so much traffic, that demand for taking the trips will fall, if it takes so much time to go from one point to another. Congestion reaches a level that there is no more traffic coming through. Of course, that's not the solution because it will waste much of people's time in traffic. You can solve this problem in several different ways. Another way to solve congestion problem is to ban all traffic. If you ban all traffic, you close up the streets then by definition there will be no more congestion. But this will not be good for
society because it will be very difficult for people, goods etc. to get around. Then of course you can work on the capacity of the streets, of the roads. The typical way to increase capacity is to build new roads, to build wider roads. Then we can see what we can do in order to increase capacity on the same space. There are different solutions for that, for example the possibility to drive closer, to decrease [vertical] distances between the cars, which will increase capacity on the road. You can also do that in a horizontal way, because maybe these vehicles will be able to keep the lane very precisely. Today lanes are a bit wide because it is considered cars can move a bit around. But if you have vehicles that are able to keep the lane with high precision you can decrease the width of the road. You can also look at times when you have much traffic; peak hours, such as when you have high volumes of traffic coming into the city in the morning and in the evening it's going the other way around, you have much traffic going out of the city. In this case you can have variable lanes that are either on the one or on the other direction. In this case it's also an issue that there is hard separation material between two directions; we have to find a way to move this separation. There are ways to do that. Then we could of course take out the emergency lane of the motorway in peak hours, when there is a lot of traffic. There are also the so-called High Occupancy Vehicle (HOV) lanes, something that was done in the United States; you can use those lanes if there are more people in the same car. So one way to reduce congestion is to have more people on the same car. Today on average in Denmark there is 1, 4 people in the car, which typically could be 4 people. So when you get more people into the car you'll get a new way to reduce congestion. But if you look historically, you'll see fewer and fewer people are getting into the same car; are driving together. So it's not given you can have more people in the same car. Therefore, if you want to have more people to do it you have to put incentives for that, and HOV lanes are such one. They will be an incentive for more people to drive together. The problem is that if you get them in one lane you're actually taking up capacity on the road. So it's only a solution that will actually decrease capacity if you don't have people who choose to drive together. If you still have one person in the car it will not increase capacity to take out a lane that will be used by just one car. It might be that 80% of traffic is cars with one or two people, so you need some incentives for people to drive together. You can tax cars, tax fuel, you can have road pricing to split traffic so that people use the capacity outside peak hours. So the problem is peak hours, it's not going out, it's not in the middle of the day but its peak hours when capacity is a scarce resource.

3- Do you think shared cars can replace public buses?

If we look into a scenario with AV, the distinction between a car where people are driving together and a public bus will not be that important. Basically the main cost in public transport is the labor cost, the wage you have to pay to the driver. Therefore buses are typically of high capacity to cover this cost. But if you don't have this labor cost you can decrease the size of the bus and increase the frequency - how often the public transport will pass by the stop - and also expand the network. So it can be much closer to where you need to be and it can pick you up at much closer to where you are. In that regard, yes I think it can have some impact on public transport, on the network and the frequency.

4- What about the legislative framework for AVs? Is it ready? Are there any preparations being made at the moment?

Legislation is at different levels; there is international and domestic legislation. A lot of countries, including Denmark have signed Vienna Convention which has specific limits and what it does is it requires that all vehicles must have a driver who is able to control their vehicle or guide their animals. It's from 1968, it's quite old, that's why it includes animals...You cannot have AV on a road before we change that convention, at least at a commercial level. However, we can make tests with AV and as long as this legislation will be passed, anybody who is interested will be able to apply from July 1st for a test with AV. However now legislation does not require that you have your hands on the wheel and your feet on the pedals. It requires that you pay attention all the time, you understand traffic, the traffic surroundings and you're ready to take over control of the vehicle.

5- Could you state some of the important ethical and liability issues regarding AV?

It is often put forward in discussion what should the vehicle do in a situation when an accident is inevitable and AV is going to choose if it's going up to an old woman or a mother with her child; and of course the situation there has to be taken into account. There is also a question on how you use
capacity on a road. For example, if you drive to Copenhagen in the morning and you leave in the afternoon you’ll pay a rather big amount of money for parking. There might be the possibility that the car moves around the city and comes after you finish your shopping and picks you up. Of course in that case we would have a ridiculous situation where empty cars would move around the city without reason. In another case the car could move out of the city center and park by itself. And that’s a good idea, it will not take parking space in the city, it could drive empty to park and then drive empty to come back and pick you up. It sounds a good thing. There will also be a lot of dilemmas in the transition period when you have a mix of autonomous cars and conventional cars; and it might be difficult because there are things you can't do in mixed traffic. It will create situations where you have… For example we made a test with truck platooning in Denmark last May where the trucks that were connected could drive closer to each other, save energy and increase safety. Trucks were driving at 80 km/h (which was the speed limit) and another truck was overtaking them at 81 km/h. It was a situation where this truck did not have to overtake one truck but three, meaning all traffic was stuck behind the trucks in both lanes for let's say for a minute. This is not good utilization of capacity. That is an increase in congestion. So there will be a lot of situations you are about to face in the transition period and then you need to be able to optimize replacement along the way.

6- What about the implementation of autonomous mobility politically? Which powers in the society will support them and which will oppose them?

Basically AV is a good thing, so I don’t see many reasons why they should not be supported. Of course there is a question on how risk-willing the politicians are. Some might be more risk-willing than others. And of course there are politicians who are very much in favor of roads and there are politicians who are very much in favor of public transport. The politicians who are in favor of roads should give the opportunity because this thing is going to increase safety for society, while politicians who are in favor of public transport might prevent it. It’s going to be some time in the future when we will still have congestion problems and then we’ll need public transport to relieve a part of congestion, like also walking and cycling.

Maria Vestergaard, M.Sc., PhD Team coordinator Team SMART Mobility. Department of Mobility, Aalborg Municipality.

1- Why is Astrupstien chosen for his project?

M.S.H.: I think we have a lot of infrastructure which could be used in a better way than today. It is located in an area where we have some people that might be not so mobile and public transport today is not so good. That's why we think this path should provide a much better connection; in the future also with +BUS our BRT network.

2- The Aalborg East project a part of a greater regeneration project?

M.S.H.: The trial is not just to test the technology. It's also to test how people are looking at this kind of technology. Can we integrate this kind of technology in an area where people feel connected with and protecting this kind of technology? Can we also engage the youth? Do they have some kind of responsibility to take care of it instead of destroying it, painting on it and so on? There are a lot of different kinds of elements in the test. Then of course in a larger scale we'd like to see, is it a kind of public transport that we can transfer to other areas here in Aalborg? Also because in Denmark wages are a very expensive part of Public transport. So of course this kind of technology is still expensive, but it's going so fast manufacturing this kind of vehicles, while data transfer will not be so expensive. It's electric, still it will be quite expensive to use electricity; there are different rules when you use it on a train, than to use it in a vehicle. We are trying to push this legislation so they remove a high part of taxes on the electricity of public transport. When they take taxes away it will be cheap to have electricity for public transport, so I think it will be a competitive mode where we don't have the expensive wages to run this kind of transport; and I think it can provide mobility particularly for young and elderly people. That's the kind of the trial.
3- Which is the legal framework for such trials?

There is law – an amendment to the current law – in the national political system saying that it will be allowed from 1 July to do this kind of test with this kind of vehicles. We are still discussing a lot of issues with the ministry of transport about traffic safety issues on the vehicles, surveillance of the vehicles, how or where will the vehicles engage if it’s something wrong in the vehicle, because we will apply for a test where we do not have a person present in the vehicle and that is a bit ambitious actually. So we should provide a lot of confirmation about different situations. For example if vehicle stops but doors do not open, who will be there, or how long it can be until a person is there to open the doors of the buses. Or will it be something it can be done through the surveillance system, where we have people sitting behind screens and looking at everything; for example can they push a button? How are they going to respond? Text says vehicles shall have mirrors, but does it make sense? So there is a lot of huge and minor issues about how it will be done. Law says we need an assessor [for the test] but the people who are educated to be assessors come from the railway industry, which is another technology; other security issues. So there is a discussion who is it that is going to assess our project and put a stamp this is clear this is not clear and so on?

4- Which will be the role of this mobility service? Which kind of land uses will it connect?

It can be a broad group of uses. We have several destinations along this path, stretch is 2, 1 kilometers. This is what we'd like in years [presenting the plan of the stretch of the second phase, included in the appendix]. To connect the whole Astrup path with BRT, so that the people leaving along this path can take the bus and go to the University hospital or to the city Centre. When planning the whole project about Aalborg East and having all discussions with related stakeholders (developers, University, real estate companies etc.) people leaving in those residences said they would like to have public transport nearer to them. However when it [driverless bus idea] first popped up most people was laughing. They said, no It's never going to happen. Path also serves health center, where possibly some not so mobile people will want to go.

5- Which mobility’s restrictions do these people face for instance elderly?

Along this path man elderly people leave, that might be no so good in walking, especially in long distances. There are also disabled people in institutions around there, young people that should be transported to the school; and their parents may want them to be safer and put them on the bus. So I think we have different groups of people.

6- Is it an area with low car ownership levels?

Yes it is actually. It has been for quite some years some of the lower income groups of people that are living here, so car ownership is also quite low. So by providing different kinds of modes of mobility to the people we are also medicating low car ownership. That's why we around the city are also making better conditions for the cyclists, we create +BUS system. I also know housing companies which have put in car sharing concepts, so through our rent you are also able to book a car. Therefore there are different modes provided to people out there.

7- How many years from now do you think “driverless” boats will be introduced?

Five may be. But legislation we have for that kind of means is worse than the one we have for trains. We are still part of EU and a lot of legislations also come from different kinds of conventions or EU laws, so that’s a bit “heavier” system to control. Buy maybe we can make some trials as well.

8- Why do you think we should implement driverless mobility, in general?

I think it provides us first of all a new type of mobility. The first one we are making here is not so flexible, but we can make it more flexible. We can make it so that people can use an app or something and then have their vehicle at their door within 5 – 10 minutes or something like that; at least in a
small system like this. We could have one bus actually going to people who are not able to walk, pick them up from their door and make them a logistic route. That could be a phase two of this trial in a few years, but that's what we'll decide when we're prolonging trial for two more years. So I think this kind of technology will give us a better option to use existing infrastructure we have. They use lesser space, they can pass each other in very little space, we don't have to have so wide roads as today and we can get much closer to people than today. So I think we can have some good options that vehicles we have today are not able to provide; and maybe also cheaper. As a piece of equipment is very expensive, but it will probably become cheaper. As our mobile phones and other technologies eventually became cheap I think it will be the same kind of development in this type of vehicles.

9-I see from websites and google maps that there is cyclists are on the same path how will cyclists “coordinate” with buses” movement?

For now it will be the buses that are coordinated with cyclists. The bus has cameras and sensors outside it, so it will see if cyclists are coming. So if cyclists are not moving behind this bus the other bus will stop. If bus sees it has a free path then it will pass. And of course this will be interesting because we'll see how polite will cyclists be. They may be so polite than when they see a bus coming they move back, for the bus to pass, we'll see. Otherwise the bus will stop and cyclists will pass.

10- How fast will buses run?

Speed is not entirely decided yet; I think we'll start at 20 km/h, then 25 then 30 km/h, because maximum allowed speed in this path is 30 km/h. But this kind of mobility is not designed, as it is here, to be high speed. It's not the purpose. So if it will be able to run about 25 km/h it will be fine.

11- Do you think technology is ready for that?

Yes I do think it's ready, otherwise it would be too risky. But in this project what we have actually done is to minimize the risks. It's not running with other vehicles or in public roads. It's still a path. And it is not running that fast; 25 km is not so fast. In that sense we have minimized the risks, compared to running it somewhere in the city, among other vehicles.

12- What about liability and ethics of driverless vehicles?

I know a lot of factors on that. Actually different insurance companies have set that this technology means that insurance rate will be cheaper. Because they can see the traffic safety is much better in this kind of vehicles than what we see today. So, for parking for example. It can park much better than I do. And the discussion now is if something is wrong and the vehicle causes an accident which is then the responsible part. So this is the center of discussion at the moment actually. Or if a pedestrian is walking in front of this car and it does not stop.

13- How about the acceptance it will gain by the society?

People were more reluctant before a few years than they are today. In 2014, we were asking them “Could you imagine that you would you drive with this kind of the bus where there is no driver?” and most people said “oh yes, I would do that?” I don't think they could exactly imagine what they were saying yes to, but they were willing to do something even though they did not have exact image of it. And I think today you may find even more people saying yes, no problem. Because you see often in the news today about this technology and its progress.

14- Are there any variations in the extent of AV acceptance across different parts of the population, based on e.g., education background, gender, etc.?

We don't know. This is one of the things that we want to try. A lot of people have told us how on earth could you say of implementing a thing like this in Aalborg East? They ruin anything and so on. This is one of the things also University is involved. That is the test. How we can give young people and the people in this area a connection to this. It's no sense in putting this kind of mode in the western part of
the city Hasseris where people have very expensive cars and things like that. They are not going to use this kind of transport.

**15- How about decision making in critical situations? In the example with the old lady and the child, for example [describing the example].**

These things are still discussed at the moment, e.g. who will be hurt in this case, the old man or the child.

**16- Making Aalborg East residents having a sense of ownership towards the bus would be great?**

Indeed it would be very important. We actually thought of having some of the professional graffiti painters to paint the buses.

**17- Which is your vision about future mobility’s?**

Actually my vision is painted in a latest mobility concept that people are able to move on the transport mode that suits them in the moment they want to use it. That's actually my vision. Today it's not always possible for people to take public transport because the stop may not be close to them etc. If we have a system it's easy to use; you can for example be picked up by a small car and then travel then on a fast train or bus – because that's feasible, since people want to go everywhere it would be great. So it's easy for people to make a choice. That would be the best. We'll still have problems with capacity in our roads. We have congestion, because people will still drive and what you can see is we have congestion in the morning and in the afternoon that people come back from their jobs. But you can see trips are increasing during the day. People are travelling more and more than it has been in the last many years. So that is still a need for people to get around. People sometimes say, public transport will die, nobody will want to run the public transport. But I think that's wrong. If public transport is a possibility to move fast - because that’s what people want when using public transport to go from home to work and it’s easy - people will still use public transport.
Presentation

“Selvkorende Busser i Aalborg (Self-driving Buses in Aalborg)” [In Danish]. [Presentation].

[Image of presentation slides showing contexts, timelines, and maps related to self-driving buses in Aalborg.]
Hvorfor førerløs teknologi

- Økonomisk
- Økonomisk
- Økonomisk
- Økonomisk
- Økonomisk
- Økonomisk
- Økonomisk
- Økonomisk
- Økonomisk
- Økonomisk

Teststrækning

Visionsstrækning

Tracé på Astrupstien

Teknologien - data

- Elektricitet
- Elektricitet
- Elektricitet
- Elektricitet
- Elektricitet
- Elektricitet
- Elektricitet
- Elektricitet
- Elektricitet
- Elektricitet

Aktører

DGI Landsstævne 2017 — prøv den

Tak for opmærksomheden!
Visual material

Aalborg East: “Creating a more sustainable and coherent town” (Aalborg Municipality website)

Image (8) Tornhøj bus stop.

Image (9) Astrupstien path at its existing form.
Image (10&11) “Planetcentret” shopping facilities.
Figure (4) connecting Aalborg East with the rest of the city.

Image (12) after the project applied
Image (13) after the project applied.