Urban Liveability Enhancement:
A study on reclaiming car space

Source: (Ohurtsov 2015)

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Preface

This Master Thesis is part of the Cities and Sustainability master program at Aalborg University. The research has been conducted in a group of three in order to have time to delve into the concept of liveability and its relation to the complex matter of car dependency.

This report serves as inspiration as well as a design guideline for municipal planners and private parties. A planning tool is presented in the end, which combines all the main points from the analysis and can therefore be used as a standalone feature. A complementary appendix report is referred to for elaborations on the content that is presented in this report. That appendix also contains the created planning tool.

This document is written by three people but developed in consultation with several people. Firstly, we want to thank Lars Bodum of Aalborg University. He has supervised this thesis work and gave helpful input to increase the quality of this report. Secondly, we want to thank the municipalities of Fredrikshavn, Hjørring, Randers and Skanderborg for participating in the research by having interviews and providing feedback.

We wish you a lot of reading pleasure,

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1. Summary

Due to AAU regulation the summary of this Thesis has to be in Danish. For readers that cannot read Danish, there is an English abstract of this thesis on the AAU project library.

Dette specialeprojekt tager udgangspunkt i at forstå og definere konceptet "liveability". Direkte oversat til "levedygtighed". Ved brug af et litteraturstudie identificeres seks overordnede kategorier for liveability: Helbred og sikkerhed, diversitet, social interaktion, kontrol og identitet, kontakt med naturen og regeringsledelse. Liveability i byer er derfor et bredt koncept som rammer mange dele af samfundet, og udfordringer i byer har høj tilstedeværelse i disse kategorier. Mange udfordringer i byer kan kobles sammen med bilens indtog i de danske byer. Bilens rolle og de udfordringer den har medført i byer undersøges, og det forefindes at bilen både har helbredsskadende og trafikale konsekvenser, men da bilen er blevet en integreret del af samfundet, er det ikke længere nok at udbyde ny, alternativ infrastruktur, men at påvirke folks vaner for eksempel igennem en omstrukturering af urbane områder er nødvendigt. Der bliver i denne forbindelse inddraget Jan Gehls 12 kvalitetskriterier og det fastslås gennem et bilreducerende eksempel at man gennem planlægning kan påvirke både folk, infrastruktur og liveability i byer. Denne introduktion har ledt frem til følgende fokus:
Dette specialeprojekt har til formål at undersøge hvordan liveability frameworks kan blive kombineret i et planlægningsværktøj der henvender sig til planlæggere som beskæftiger, eller vil beskæftige, sig med bilreducerende initiativer til at fremme byer for borgere og arbejde henimod bilfrie byer. For en bedre strukturel gennemgang arbejdes med tre underspørgsmål.
Grundet specialet pragmatiske tilgang gøres brug af en blanding af metoder til at svare på problemformuleringen. Litteraturstudier og dokumentanalyser bliver brugt til at finde relevant viden i alle tre underspørgsmål. Case studier bliver brugt i arbejdet med de konkrete cases fra hele verden samt i udarbejdelsen af initiativ cases. Semistrukturerede videointerviews bliver brugt til at indfange relevante refleksioner omkring det udarbejdede værktøj samt til at foreslå fremtidige forbedringer af materialet, som vil kunne optimere udnyttelsen af værktøjet set fra et planlægningsmæssigt perspektiv.

Første underspørgsmål undersøger de bagvedliggende argumenter for at bruge bilen, hvordan man kan facilitere en adfærdsændring i forhold til brugen af bilen samt hvilke almindelige mobilitetsformer som bliver anvendt i Danmark i øjeblikket.
I denne forbindelse bliver den psykologiske baggrund for at være afhængig af bilen undersøgt og det forefindes at afhængigheden af bilen ikke kun kan sættes i forbindelse med tidsbesparelser som i pendlertid, men også sociale faktorer og alene-tid spiller ind i brugen af bilen som transportmiddel. Bilen er tydeligvis er en vigtig del af mange menneskers hverdag. Da det både er fysiske såvel som psykiske argumenter som understøtter brugen af bilen, så undersøges det, med brug af John Deweys arbejde inden for området, hvordan vaner spiller en rolle i adfærd og hvordan en adfærdsændring kan skabes. Det forefindes at vaner ikke kun skabes gennem repetitive gentagelser men også gennem relationer mellem mennesker, samfund og institutioner og at vaner derved skabes også gennem minder og lykkelige stunder. Det forefindes herefter at en ændring i adfærd inden for transport derfor burde faciliteres gennem kampagner der både fokuserer på infrastrukturmæssige ændringer men ligeledes også tager højde for de psykologiske årsager bag bil afhængighed og adresserer dem ved hjælp at vanebrydelse. Sådanne initiativer kunne f.eks. være målrettet mod børns brug af aktive transportmidler, da vaner er indarbejdet i menneskers underbevidsthed og kan komme til udtryk mange år senere. Det forefindes derudover også at ændringer i sociotekniske strukturer skal ske gradvist og ikke

gennem 'top-down' tilgange. I forhold til mobilitetsformer anvendt i det danske samfund, så står bilen for hovedparten af al transport med et evigt stigende antal af biler på de danske veje. Dog forekommer der også aktive transporttyper på markedet som bliver brugt flittigt. De aktive mobilitetsformer har den signifikante fordel, at de påvirker den fysiske og mentale sundhed positivt hos alle brugere og er fra et liveability synspunkt at foretrække.
I andet underspørgsmål undersøges der hvilke designovervejelser man skal tage højde for når man planlægger liveable byer og hvilke 'best practices' løsninger findes rundt om i verden i øjeblikket med henblik på at overgå til bilfrie byområder.
Underspørgsmål to tager udgangspunkt i hvilke internationale tendenser der er inden for arbejdet med liveability. The Sustainable Development Goals og The New Urban Agenda og liveability indekser bliver præsenteret og de vigtigste elementer inden for planlægning og udvikling i byer i relation til liveability bliver identificeret med elementer fra disse frameworks. Disse elementer har dog en overordnet karakter, og det kan derfor anses som udfordrende at udnytte disse råd i en lokal kontekst. Ved hjælp af Jan Gehl og de 12 udarbejdede kvalitetskriterier for bylivskvalitet kan det konkluderes at også lokale arbejder med byområder kan have en indvirkning på liveability i byer og at dette derfor anses som den optimale måde at planlægge efter liveability.
Både utopiske og mere realitetsnære planlægningseksempler bliver herefter brugt til at præsentere helt konkrete designstrategier og initiativer for skabelsen af liveability i byer. De sidstnævnte konkrete initiativer er blevet præsenteret som 11 'best practises' cases fra internationale byer og 5 initiativer som er en samling af initiativer fra de konkrete cases.
I tredje og sidste del af analysen undersøges det hvordan den fremarbejdede viden fra de førnævnte underspørgsmål kan sammensættes i et samlet værktøj som vil skulle kunne bruges af planlæggere for at fremme liveability i deres lokalområde.
I denne del af analysen bliver erfaringerne fra den teoretiske viden brugt til at forme et værktøj til brug for planlæggere der har til formål at skabe liveable byer gennem bilreducerende initiativer. Den teoretiske viden omkring både fysiske of psykiske argumenter for brugen af bilen, adfærd og vaner, hvordan en adfærdsændring kan fremkaldes, designelementer og påvirkningen af liveability tendenser samt erfaringer fra både utopiske og konkrete cases fra hele verden bliver udnyttet. Derudover bliver erfaringer fra fire interviews foretaget med kommuner i Danmark inddraget. I disse interviews har planlæggere haft mulighed for at reflektere over tilsendt materiale samt ytret sig om overvejelser omkring de planlægningsværktøjer de allerede bruger. Disse overvejelser bliver brugt til at reflektere over det udarbejdede værktøj samt til at foreslå fremtidige forbedringer af værktøjet.

2. Framework

The majority of the world experiences population growth at a rate that has never been seen before and most of this growth takes place within cities (Marans 2015, P. 47). This is not a new phenomenon however, during the 20th century the urban population increased by more than a tenfold from 220 million at the start of the century (Martine 2007, P. 1) to 2.86 billion at the end (Ritchie en Roser 2019). According to the UN, a true milestone was reached in 2007. That was the first year in which half of the world's population lived in urban areas. This meant that 3.3 billion people were living in urban and rural settings alike (Ritchie en Roser 2019). The number of city dwellers continued to rise and in 2014 it reached 3.9 billion people (Nations 2015, p. 12), or 54% of the world's population (Nations 2015, p. 1). In 2018 this percentage has risen to approximately 55.3% of the population. Projections for the future include 60% of the population living in urban settings by 2030 (United Nations Department of Economic and Social Affairs 2018, p. 2) and a staggering 68% by 2050 (United Nations 2018).

The fast increase in urban population led to action within the United Nations. On the 31st of October 2014 the UN Secretary-General, Ban Ki-moon, stressed the importance of creating liveable cities for the lives of city dwellers, but also as a vital part for sustainable development (Ki-moon 2014). In the following years the United nations organised two significant events that pushed the sustainability and liveability to the forefront of the world's political agenda.

The first event took place in September 2015. There was a Sustainable development summit at the UN headquarters that focussed on the adoption of a new global sustainable development agenda (United Nations 2015). It was a huge success and 17 Sustainable Development Goals (SDGs) were adopted by world leaders of all UN member states. The successful Millennium Development Goals (MDGs), that were applicable from 2000 – 2015, serve as a base and the SDG's built on them in order to: "*end all forms of poverty, fight inequalities and tackle climate change, while ensuring that no one is left behind*" by 2030 (United Nations SDG 2018).

The second event took place in October 2016. The Habitat III Conference. It was the third conference in a bi-decennial cycle that focussed on ensuring global commitment to sustainable urbanization and the adoption of the New Urban Agenda (NUA) (Habitat III 2016). Within the agenda there is a framework that describes global policy for cities and other types of urban settlements. In total 167 countries signed the agreement and their progress will be reviewed to see if they manage to attain the objectives in the NUA. The objectives concern the sustainability of cities and shaping urban settings, so they provide a liveable environment (Horne and Adamson 2017). Within the NUA there is also acknowledgement of the SDGs and how it can support them. The focus herein lies mostly with SDG 11: Sustainable Cities and Communities (United Nations 2017, p. 4).

The "United 4 Smart Sustainable Cities" (U4SSC) initiative, a collaboration of 15 organisations (of which 11 are UN departments or subsidiaries), presented a report on the implementation of SDG 11 in which it states:

> *"The scope of urbanization should always include the liveable environment while also considering the global dimension. International instruments and global agendas are aimed at providing the required guidance on urbanization and development to improve the liveable environment. These include Sustainable Development Goal 11 and the New Urban Agenda."*
> (U4SSC 2017, p. 1)

It is clear that a liveable urban environment is on the forefront of the global development agenda, but it seems impossible to find a definition of the concept of liveability in the documents that highlight its importance. In order to create a full understanding of the meaning of liveability and the factors which influence it, exploration of the concept in greater detail is necessary.

2.1 The concept of Liveability

Before exploring the concept of liveability, it is important to note that the concept has been discussed in an urban context by the UN as well as the subsequent documents that followed. The exploration of the concept will therefore also focus on liveability in an urban context. Another noteworthy mention is the fact that this project does not distinguish between "Livability" and "Liveability" since they concern the same word, only a different way of spelling. The first one is the American English way of spelling it and the latter is British English. This report will stick to the British way of spelling, even if source documents make use of American English. With this framework in place, the exploration of liveability can commence.

Despite the fact that liveability as a concept has appeared frequently in research and educational readings, it is a term that is used for many different aspects and also in different circumstances by various disciplines. As the number of professionals that addresses liveability issues is on the rise, the attention for the concept has grown in recent years. While the engagement with liveability grows, the need for a clear understanding of the general concept, but in particular urban liveability becomes apparent (Kashef 2016, p. 240).

The concept is especially common and important in the field of planning, where all levels of governance use it for framing their policy and planning efforts. Although the term is commonly used within the field, it has many definitions. Defining efforts have led to a wide array of properties and themes for liveability. Most of the definitions are implicit however and have to be deduced by the reader through the use of context (Herrman and Lewis 2017, p. 1). In 2017, a literature review by Herrman and Lewis of the University of Oregon showed that only 27 out of 237 sources attempted to give a definition or explanation of the term Liveability. From these attempts it was not possible to create a uniform definition however (Herrman and Lewis 2017, p. 10).

A look in the dictionary is enough to illustrate how vague the term actually is. The Cambridge Dictionary contains following definition of liveability (Cambridge University 2020):

> *"The degree to which a place is suitable or good for living in."*

A lot of different factors and indicators can fit within this framework and after reading this definition it is still not clear what constitutes liveability. Michael Pacione was one of the first researchers to define the concept of liveability. He describes liveability as:

> *"Urban liveability is a relative term whose precise meaning depends on the place, time and purpose of the assessment and the value system of the individual assessor. This view contends that quality is not an attribute of the environment but a behaviour-related function of the interaction of environmental characteristics and person characteristics."*
> (Pacione 2001, p. 396)

The fact that liveability cannot be attributed to environmental factors alone, is also influenced by personal traits of the assessor of liveability, is a big issue in defining the term for operational use. During more recent research of Herrman and Lewis into an operational definition of liveability it was uncovered that the term is very ambiguous. They state that the term liveability is often applied as an 'umbrella' for indicators. Most notably, these indicators are determined first and then brought together under the term liveability (Herrman and Lewis

2017, p. 10). The basic needs of human life (food & water, shelter and security) are clear determinants of liveability, but when these basic needs have been fulfilled the new determinants become subjective and dependant on the judgement of people as to what comprises liveability. This also means these are not the same around the world, or even for people living within the same city (Ruth and Franklin 2014, p. 21 - 22).

The sheer diversity of factors that can be perceived as improving liveability makes it hard to summarise what exactly creates it. Another way of creating an operable framework for liveability is categorizing all the elements that have been labelled as liveable or improving liveability to see which broader topics they address. Research that tried to categorise the determinants of liveability in an urban planning context has resulted in the following six categories (Stougaard 2016, p. 38 - 41):

- **Health and Safety**, a good healthcare system, low air, water and noise pollution, provide opportunities for exercise, create a good system for active mobility, public space for safe night activity and low crime rates.
- **Diversity** in housing, demography, lifestyle, transport and income.
- **Social interaction**, tolerance (in both mindset and public space that is accessible to all), associations for sport, music etc and relations to neighbours.
- **Control and Identity**, perceived freedom, personalisation of the environment and the creation of identity.
- **Contact with nature**, urban greenery, access to parks, forests, beaches and surface water.
- **Governance**, inspire, create visions and promote democracy.

Now the factors that constitute liveability in a planning context have been identified it is important to take a look at the different kinds of liveability that can be identified and how they relate to urban planning. In 2012 Van Dorst combined research of himself as well as others to create a comprehensive explanation of the three different types of liveability that can be distinguished. These are visible on the next page.

1. **Perceived liveability** – How an individual appraises his or her environment.

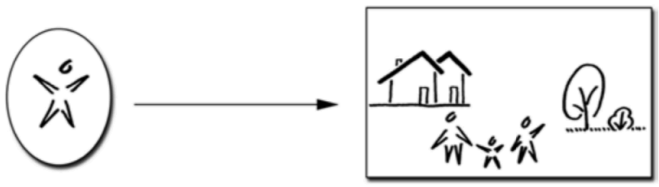

Image 1: Perceived liveability (van Dorst 2012, p. 226)

2. **Apparent liveability** – A perfect match between a species and its environment.

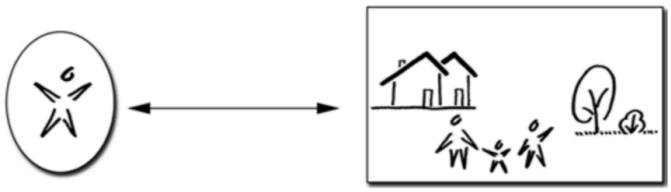

Image 2: Apparent liveability (van Dorst 2012, p. 226)

3. **Presumed liveability** – How well an environment meets the presumed conditions for liveability.

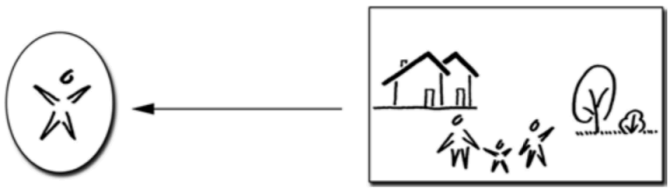

Image 3: Presumed liveability (van Dorst 2012, p. 226)

Of these three only the perceived and the presumed liveability are of interest to urban planners. Apparent liveability is mostly used to determine if a habitat or environment is suitable for certain animals or plants, as it is easy to define environmental qualities that make the optimal environment for them. As humans are highly adaptable, they learn and remember, making it near impossible to define a clear set of environmental qualities in which humans thrive. The measure for human apparent liveability is happy years of life, which can only be measured at the end of it and this makes it very unpractical for use by planners (van Dorst 2012, p. 226).

The perceived liveability is determined by asking individuals to rate their living environment (van Dorst 2012, p. 225). This can be used to generate knowledge by obtaining valuable information. This gives decision makers a better basis for planning and prioritising public spaces in order to improve life within the city (Norn, Ramboll 2018).
The presumed liveability in a city is called this way because the exact influence of changes in the physical environment on liveability is not known. There is just a set of indicators that can describe an expected influence of developments on urban liveability. Perceived liveability studies can serve as input for presumed liveability by providing indicators and therefore make the presumed liveability of planned developments more accurate. However, this still does not mean the expected outcome will hold up in reality (van Dorst 2012, p. 227). When planners talk about the liveability enhancements of projects they propose, this always concerns presumed liveability.

2.2 The rise of the car and liveability issues

The car poses more problems to human life than most people realise. It is not only the risk of death or injury caused by accidents, but it encompasses much more. Liveability is also highly affected by car usage. For example, it has been proven that people who live on less trafficked streets are more socially active, have more friends and social connections. According to three Egyptian researchers the car affects the following aspects of liveability (Adbelhamid, Elfakharany and Elfakharany 2018, p. 2):

- **Social interaction**
- **Health**, by negatively impacting all aspects of human biological and psychological well-being

These aspects indicate that the car has a profound impact on the liveability of an urban environment. This statement however raises the question: Why does the car have such a prominent place in the urban environment? In order to formulate an answer to this question it is necessary to take a closer look at city development over the last 150 years.

An Italian physicist by the name of Cesare Marchetti described a principle in 1994 that is known now as the 'Marchetti Constant'. This constant describes that people, on average, are willing to commute for half an hour from home to work in a one-way trip. The Marchetti Constant has a huge impact on urban life, because the speed of available transportation options defines how far people are willing to travel and therefore how big urban areas can grow (English 2019). This meant that during the industrialization of the late 19th century the development of mechanized transportation options made huge urban expansion possible (Fainstein 2019). In America the first urban boom happened around that time and urban areas expanded exponentially. Whereas a walkable city around that time could have a diameter of 3.2 km and cover 7.8 km^2, a car centric city could have a diameter of 12.9 km and cover 129.5 km^2 (English 2019). Cars and buses congested the streets of the older parts of cities in a rapid pace and by doing so, they made the need for more orderly traffic circulation systems apparent. The focus of planning activities shifted more and more to the transportation networks in urban areas. The main investments of municipalities were in the widening and extension of the road network (Fainstein 2019). This focus of investment led to car dependent cities. Their growth, in both size as traffic volume, led to an urban transit system that became ever more dysfunctional (Parapari 2010, p. 15). The road network and its connected parking facilities became a bottomless pit that absorbed any new capacity and put new capacity constraints on the system. The newly absorbed capacity meant that car traffic exploded at exponential rate again until this excess capacity was filled (Newman and Kenworthy 1999, p. 59). This dysfunctionality of the system illustrates the need for a fundamental shift in the connection between transport and land use (Parapari 2010, p. 15).

The cycle in Image 4 illustrates why most urban areas and people still rely on the private car as a common means of transportation.

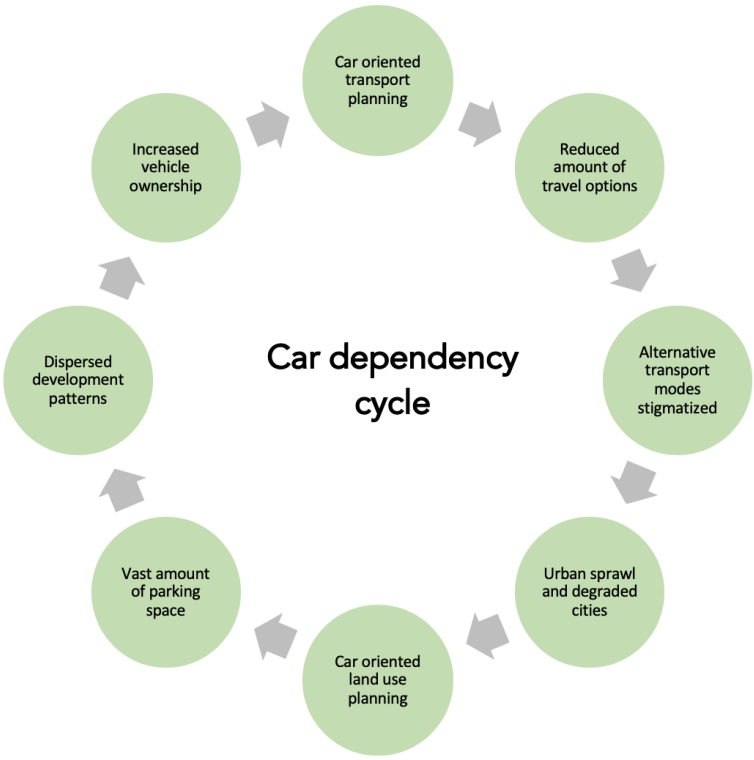

Image 4: Car dependency cycle (Parapari 2010, p. 16)

The dependency on the car does not only have negative effects on the environment, but also on land usage and planning. It simply takes up too much space. This means that a transition to electric autonomous vehicles is not enough. Urban areas need to reduce the number of cars and support a variety of transportation modes that favour active modes of transport, mass transit and shared mobility (Sumantran, Fine and Gonsalvez 2017).

2.3 The car in daily life

Due to car ownership by the masses, developers were freed from the need of providing easily accessible public transport for all in the wake of the Second World War. This change in mobility led to the creation of suburbs, because amenities no longer needed to be in walk or biking distance. Combined with the aspirations of people to own a house with a garden, investments in car infrastructure and the car manufacturers aggressive lobby tactics, the rise of suburban life led to the car becoming the preferred mode of transportation of people (McVean 2013).

Fast forward to the present and many forms of suburban development have taken place. Satellite cities and new towns are examples. The bigger city in a region often functions as an employment hub that draws in commuters from the surrounding area (Kotzeva 2016, p. 195). People who live nowhere near a city centre have few choices other than to rely on the car for their commute to work and to cover their daily needs. As McVean puts it in his lecture at the university of Cambridge:

"Now those who live in suburbia have little choice but to drive – trapped in a vicious cycle of car dependency as the separation of land uses continues to place jobs and services beyond the reach of those on foot, while low densities make the running of decent public transport nigh on impossible – and most people looking for a new home have little choice but to buy in suburbia."
(McVean 2013)

After the global economic crisis of 2008 there was a very notable reduction in the construction of housing. Especially social housing was hit hard as governments limited their investments. Most of the development that still took place was focussed on luxury buildings. Now the economy is up and running again the housing prices in cities have skyrocketed and many city dwellers deem it necessary to move to suburban or rural areas in order to attain affordable housing (Kotzeva 2016, p. 204).

Another contribution to the relocation of people from the city to a more suburban context is the rise of telecommuting (or telework). Because these people do not have to be at work every day of the week, they accept longer commute times and acquire a house in a town, rural area or green urban setting. After this acquisition telecommuters are not more prone to change their residence than non-telecommuters, because they see this way of working as a permanent change (Muhammad, et al. 2007, p. 356).

For both of these groups it means that they are most probable to use their car when they have to go to their company or the city in general. This leads to an enormous influx in cars within the 'bigger' city limits, because of this influx buildings and neighbourhoods have been torn down to provide roads and parking space in order to bring them into the city centre (McVean 2013).

The town these people live in might not be in the same municipality as the city they travel to. This high degree of mobility the car offers has led to daily transport that transcends the municipal borders. People move over these borders without thinking about it. This leads to problems within cities however, because numerous cars within the city originate from beyond their municipal borders (Turcotte 2011, p. 28). The municipality where they originate might not view these cars as problematic and therefore take no action. Cooperation and coordination between municipalities is necessary in regard to transport planning (Woldeamanuel 2016, p. 26) and often absent (Harmaajärvi, Heinonen and Lahti 2004, p. 6). The

suburban commuter will continue to rely on the car until they are provided with a satisfactory alternative means of transport (Sturgis 2015).

The suburbs are typically denoted as a very good place to raise children (Dyck 2005, p. 163). It is yet another reason why people move to the suburbia. This also means that commuting from and to the city is not the only transportation need for people within these communities. The activities of these people consist out of work, bringing or getting something or someone, social and leisure activities. This set spans the spectrum of obligatory and flexible activities people undertake (Rasouli and Timmermans 2014, p. 33). In the western world it is ever more common that both people in a relationship work. This can be either part-time or full-time. Since 2017 the traditional model with a stay at home mom and a full-time working dad is prevalent in less than 1 in 10 households in Denmark, Belgium, France, Sweden and Norway (OECD 2017). The fact that women with children no longer stay at home changes the movement patterns of both partners. New patterns that arise are dependent on activities that normally would befall the parent that remained at home. Dropping the kids of at school before work, picking them up again after work and grocery shopping are good examples of this. These activities are usually carried out on the way to work or on the way back. This makes their trips not a simple A to B movement but from A to B via point C and D or maybe even E. In order to make trips like this in a timely fashion a transport mode that is available, flexible, reliable and timely is necessary. The car fulfils an instrumental role in this regard (Kent 2014, p. 109). Mornings in a two-income household with kids are hectic. Unexpected things happen and make it difficult to leave the house every day at the same time. The need to plan a trip in advance and leave at a designated time is therefore considered undesirable. If missing a bus or train results in children being significantly late for school and parents being equally late for work, they will not take that chance. Because the car does not require a set departure time to be on time or suffer just a slight delay, this is the preferred mode of transport (Kent 2014, p. 110). As Kent puts it:

"Individual decisions to drive are not necessarily motivated by the desire to save time. Instead, automobility is sustained by appeals to flexibility and autonomy."
(Kent 2014, p. 103)

The abandoning of this flexibility and autonomy by stepping away from the car and into other modes of transport currently entails more than just a different transport mode, but a change in the practices of daily life (Kent 2014, p. 110).

2.4 The next step

It is clear why humans rely on their cars so much for transportation. Still, it is an undesirable practice in the light of urban liveability. One of the people on the forefront of creating liveable cities is Jan Gehl. He has been vocally advocating the creation of cities that focus on the people living in them instead of the cars flowing through them since the 1960's. He says that city planning has focussed on keeping cars happy for too long and it is time to look at how the urban environment impacts the lives that are lived within it instead of the efficiency of car use and parking spaces (Bramley 2014). The following quote conveys his feelings towards the car very well:

"The car is a lousy technical solution today. It is 115 years old and comes from the Wild West in Detroit. It was probably a good idea back when cities were small, and you actually lived in the Wild West."

(Gehl, Mennesket i centrum for byernes udvikling 2016)

Gehl expresses his disbelieve about the fact that humanity has done more research into the habitats of panda bears and gorilla's than it has into the urban habitat of the human race. He claims that since the first publication of the urbanist Jane Jacobs in 1961, maybe 10 people have done serious research into the matter. The most notable among them are: William Whyte, Donald Appleyard, Christopher Alexander and Allen Jacobs (Gehl, Cities for People: A Q&A with Architect Jan Gehl 2010). In the year 2000 Gehl started a consultancy firm in order to put the theory of all these researchers into practice all around the world (Gehl, Cities for People: A Q&A with Architect Jan Gehl 2010) (Gehl 2020). He has worked together with numerous cities around the world to create spaces which are created for humans. He does this by reclaiming space that is dedicated to the car and allocating it to the people (Orsman 2010). This requires a shift from car-centric city design to people-centric city design. Cases he worked on include metropoles like London, New York, Copenhagen, Buenos Aires, Mexico City, San Francisco, Shanghai, Melbourne and many more (Gehl 2019). His work has netted him several prestigious prizes and the title of 'the last living worldwide renowned guru in urbanism' (Costello 2015). So, how does Gehl create these success stories?

In 1965 Gehl and his wife developed an approach to increasing liveability in public space that was data driven. They called it 'PSPL analysis', which stands for Public Space / Public Life analysis. They started to count the amount of people in a public space and assessed how they were using it. The data that was generated in this way served as the base off which recommendations were made for improving liveability. Throughout the years Gehl refined these principles and they are still applied to existing cities and new developments (Bramley 2014). In 2015 he launched the Gehl institute in order to offer strategies that capitalize on pedestrian data to create an understanding of human behaviour which can serve as input for human-centric architecture (Goldsmith 2019). His analysis is built around 12 quality criteria for the city at an eye level to assess how liveable a space is. These are visible in Image 5 on the next page. Gehl's analysis is an operational way of assessing the liveability within an urban area but reclaiming space from the car is easier said than done.

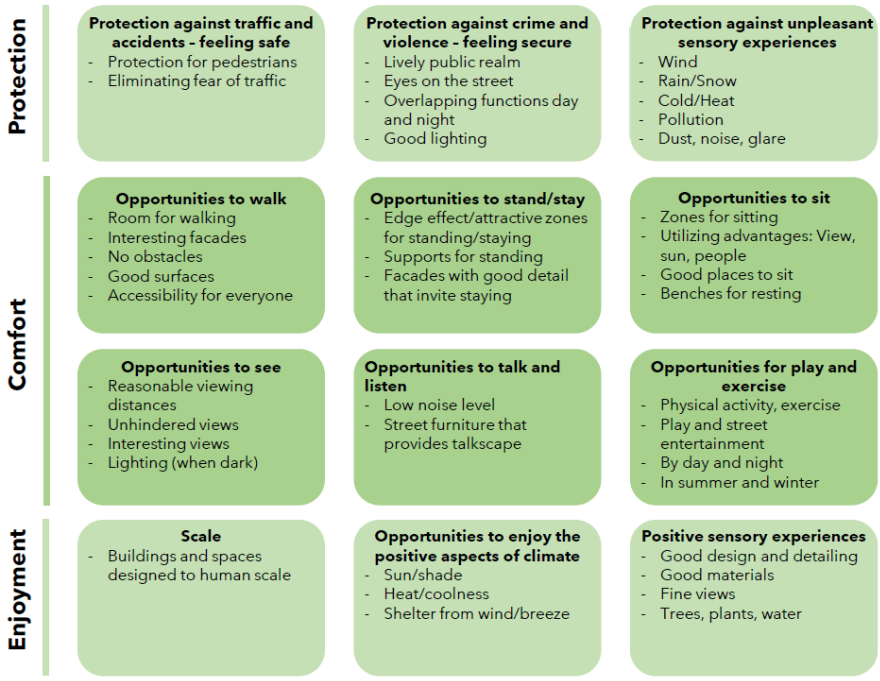

Image 5: Gehl's quality criteria for the city at eye level (based on (Gehl, Gemsøe, et al. 2006))

2.5 Reclaiming space from the car

There are different lengths to which a planner can go to reclaim space from the private car, but the most extreme measure is the creation of car free cities. The name might raise the suspicion that no vehicles are allowed into the town or city, but it concerns a shift from private vehicles in favour of walking, cycling and zero emission rapid transit like E-buses, trams, trains, light rail and subways (Unlocking Sustainable Cities 2018). Car free solutions in general omit the public cars like police vehicles and ambulances as well as vehicles that transport heavy goods as they are seen as a public need that plays an essential role in the economic activity of the city (Nieuwenhuijsen and Khreis 2016, p. 253). By transitioning into a car free city there are health and environmental benefits from reduced pollution, health benefits for people because they are more active and health benefits from additional green space and social interaction. Because these factors all benefit the sustainability of an environment greatly, the European Commission is a supporter of car free initiatives (European Commision 2016). Cities that adopt car free initiatives are not only banning private cars, but they also provide reasonable transport alternatives to their citizens and an appealing vision for the public realm into which it can transition (Nieuwenhuijsen and Khreis 2016, p. 254).

The car free city sounds very abstract and utopian, but there are cities which have adopted and implemented the idea successfully. An early adopter is the city of Pontevedra in Spain, a city of 83.000 inhabitants, which turned out as a success story (City Population 2019). It was a city where around 27.000 cars passed the Spain Plaza in the historic centre every single day (Global Site Plans 2014). The local politician Miguel Anxo Fernández Lores noticed the following problem:

"The old city was not designed for this traffic. The pedestrians fled, cyclists disappeared, and the centre became a desert. The city had become a heap of cars."
(Global Site Plans 2014)

After 12 years in the opposition he became mayor of Pontevedra in 1999 and still is in seat today (Burgen 2018). His program to become mayor was very simple. He promised to give the city back to the people, with a focus on the vulnerable groups of society (Global Site Plans 2014). The reasoning of his party behind this program was:

"Owning a car doesn't give you the right to occupy the public space (…), so how can it be that the elderly or children aren't able to use the street because of cars?"
(Burgen 2018)

Mayor Lores held true to his word and within the first month in office, he pedestrianized the entire old town of 300.000 m^2. He did not stop there however: they prevented cars crossing the city, eliminated parking spaces, surface parking was eradicated in the city centre, traffic lights made place for roundabouts and speed limits of 20 to 30 km per hour were introduced in the city (Burgen 2018). As a further addition, the pedestrianized zone was expanded from the centre to the outskirts of the city. Currently around 65.000 residents of the total 83.000 live within a pedestrianized area. In order to make the streets safe and comfortable, street lighting was improved, benches were installed, and playgrounds and green areas were constructed (Global Site Plans 2014). The policy has been in place for two decades now and its effects are clear, and they are numerous (Velasquez 2018).

A shocking example is the mortality rate in traffic accidents. On streets where 30 people died between 1996 and 2006 nobody has died within the last decade. CO2 emissions went down by 70% (Burgen 2018), traffic has decreased by 77% in the city and its population has risen by 12.000 since the car free policy took effect (Guðmundsdóttir 2019). Most importantly, people roam the streets again: 70% of all trips are made on foot now (Global Site Plans 2014). An example of this transition from car lined streets to people centric streets is visible in Image 6.

Image 6: The transformation of a street in Pontevedra (Council of Pontevedra 2017, p. 10)

Small businesses blossom in Pontevedra, while they often struggle for survival in the rest of Spain (Burgen 2018). The city also attracts a lot of families who want to raise kids. Since the pedestrianization of the city, the amount of kids between the ages of 0 and 14 has risen by 8%. This is very high in comparison to the two economic hubs in Galicia which saw a growth in this population of 3.2 and 2.4 percent. Residents report the streets to be a safe environment, which also explains why it is a common sight to see children play on the streets and 80% of the children walk alone to their schools (Velasquez 2018).

Most impressive is that the works received no regional or national funding but were all funded by Pontevedra itself. Mayor Lores notes that these projects were all 'everyday public works' that cost no more than car centred options (Burgen 2018).

A project like this is not without its critics and they can serve as a good learning opportunity for other places. The first point Lores raises is the fact that people do not like to be told where they can and cannot drive. This freedom is however not a right, but a privilege and people should become more aware of that. In cases of marriage and funerals in the car free zone, the bride and groom or direct family of the deceased can come by car, but the rest of the attendees have to walk. The main complaint is the congestion outside of the car free zone where people complain there are not enough parking spaces and there is no public transportation from the peripheral car parks to the city centre. A local architect explains that this is unnecessary because any point in the city is within 25 min walking distance, but people perceive it as a hassle in daily life. People also note the absence of sheltered transportation options which are very welcome when it rains (Burgen 2018).

Pontevedra is still developing and redeveloping itself and therefore is not done with reclaiming space from the car yet (Council of Pontevedra 2016). As a pioneer in car free city design Pontevedra shows the world that it does not cost a lot of money to reclaim space from the car, but it does consume a lot of time to become car free. It is a transition process that takes decades to complete, with multiple steps on the way. However, only small steps

are being taken worldwide. Over 2.000 cities world-wide have participated in the annual World Car-Free Day (Hong 2019). By hosting this event, people get involved in urban planning by giving them a tangible experience of how the city could be with different mobility choices. This opens up opportunities for more interactive and participatory urban planning (Badiozamani 2003, p. 303).

Although there is research that is done into car free cities, it mostly explores the effects of going car free and does not give the municipal planner tools that help to facilitate the transition into a car free city. As a result, many cities see the importance of a shift towards a transport system that does not depend on private cars, but struggle with the transition to it. Research is needed into cities that are forefront of this transition in order to create feasible scenarios and strategies which are founded on research evidence to help facilitate the transition towards healthier cities (Nieuwenhuijsen, et al. 2018, p. 199).

2.6 Scope of the research

In an endeavour to tackle the subject of urban liveability it is necessary to scope the research. This adds focus and more structure to it. As Aalborg University is situated in Denmark it is most logical to take a look at the situation within the country to assess if it is a viable case area.

Denmark (as a UN member) subscribed to the SDG's and therefore is obliged to strive for sustainability in every aspect of life. Because liveability is an integral part of this, they are striving to make their urban areas more liveable. An example of their efforts to create a more liveable society is the Smart City Network. It was established in 2013 by the Danish Ministry of Housing, Urban and Rural affairs and Aarhus University (Smart Aarhus 2015). The network consists of many governmental and municipal stakeholders with scientific institutions with the common goal of creating liveable smart cities (Danish Ministry of Housing, Urban and Rural affairs, Copenhagen, Aarhus and Sonderborg Municipalities and the Danish Energy Agency 2014, p. 7).

Although it seems that Danish law does not recite the word liveability, the national government strives to implement it into the society. A prime example of a city that has adopted liveability is Copenhagen. It usually competes for the top spot on lists that assess liveability in cities on a global scale. The grand prize has befallen it several times. In 2013 and 2014 it took the top spot in the list of Monocle, a renowned lifestyle magazine (Midtgaard 2016). In 2016 it was named the most liveable city by Metropolis (Worley 2016) and in 2019 the global mobility experts of ECA International named Copenhagen the most liveable in the world (Smart Cities World 2019). The most valued aspects of the city is its high modal share of biking and its green infrastructure that offers public greenery which is also used as a climate adaptation measure (Worley 2016) (Midtgaard 2016). The Americans have even made a verb out of the city's name: 'Copenhagenizing'. At first it only referred to the adaptation of bike infrastructure, but in more recent years countries from all around the world have started to study and copy the urban planning of Copenhagen and the Nordics (Rambøll 1 2018, p. 3).

A Danish company that was involved in Copenhagen's stride for liveability was Rambøll. The company has been working together with the city in order to improve living conditions for its residents for over three decades (Rambøll 1 2018, p. 3). A couple of examples to illustrate their involvement: they worked on Copenhagen's plans to become carbon neutral in 2025 (Rambøll 2016), the construction of Nordhavnen area (Rambøll 2010) and they organise the yearly Urban Labs within Copenhagen (Rambøll 2 2018). The company is not only active within Denmark however and they carry out projects concerning liveability in cities all over the world. Singapore, New York, Berlin, Portland and Tianjin are a couple of examples that illustrate their widespread presence (Rambøll 2015). In order to do this, they founded the Liveable Cities Lab. It is a research and innovation lab that supports cities in creating a development strategy that ensures a liveable future (Rambøll 2014). Rambøll is at the forefront of liveable development and it set out to identify liveability in a Danish context, so it can provide tailored solutions. In late 2017 they surveyed 3.200 Danish citizens from 7 different cities (the five biggest Danish cities, Vejle and Køge) (Rambøll 2017) in order to assess what they experience to be the building blocks of a liveable environment (Rambøll 1 2018, p. 4). From this study they deduced seven factors that are highly important for the liveability of a city. These factors are visible in Image 7.

Image 7: The seven building blocks of liveability in Denmark (Rambøll 1 2018, p. 4)

The identified building blocks of liveability in a Danish context offer key insights for decision makers with long term visions. However, the survey illustrated another important factor. It is the need of cities to cooperate and learn from each other, so it is possible to form best practices (Rambøll 1 2018, p. 4).

In short this means that Denmark is a country in which liveability issues are on the public agenda and this makes it a suitable case area for this research. From a practical point of view, it is best to limit the search for partner municipalities to the regions of Nordjylland and Midtjylland. This limitation is useful from a mobility and financial perspective, as longer travel distances for interviews and workshops consume more time and money. Within these regions lie the Business region Aarhus and the Business region Northern Jutland. These are of particular interest because they are focussed on mobility and the promotion of their region in the best possible way by also focussing on liveability (Norn, Landbo, et al. 2016).

The biggest cities in these regions (Aalborg and Aarhus) are not considered as case areas, because they function as the 'hub' city of the region and therefore attract more investment, research and development. The surrounding towns and cities are heavily car dependent for their travel to these economic hubs and are therefore the most interesting case areas in light of the theme of this research.

3. Research Design

In order to give shape to the research it is important to create a clear formulation of the problem, a research question, its underlying sub-questions and underlying theories of science. This chapter will cover the mentioned subjects.

3.1 Problem Statement

In order to create a research question, it is necessary to have a firm grasp on the issues at hand and in which direction the solution of the problem lies. For this research it is important to understand that cars in cities originate from both within as well as outside of the municipal borders, but this is not directly incorporated into the problem statement. The problem statement reads as follows:

The car creates a diversity of liveability issues in cities by occupying a lot of space, polluting the environment and pushing people out of public space, therefore it is important to reduce car dependency and reclaim space of the car for people by creating a transition into car free cities.

3.2 Research Question

In order to do research, a research question has to be posed that addresses the topics of the problem statement. The following research question was posed:

"How can liveability strategies be combined as a tool to be used by city planners in order to reclaim space from the car, create more public space for people and transition into car free cities?"

Answering a multifaceted question like this in one go is near impossible. In order to enable the formulation of a proper answer, the following sub-questions have been posed:

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1. Why do people use the car, how can a behavioural shift be induced, and which transport options are commonly available in Denmark?
2. What are the main design considerations for liveable urban space and which best practices for transitioning into car free cities are there?
3. How can the information from previous sub-questions be used to serve as a planning tool?

3.3 Research Process

In order to create a clear overview of the activities which have to be carried out to formulate an answer to the research question, a visual representation of the process has been made. The research process is visible in Image 8.

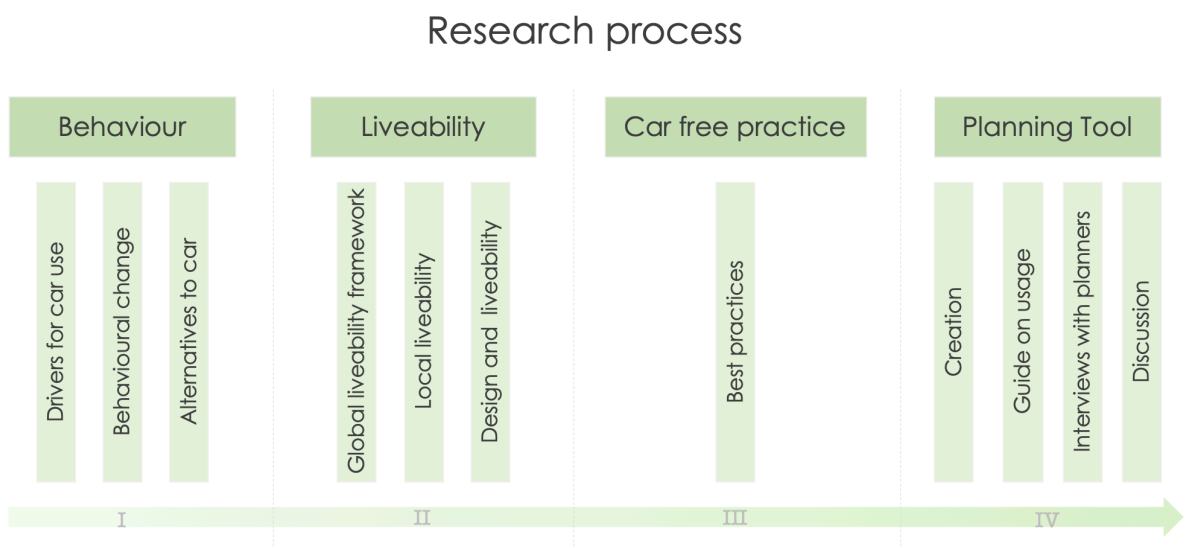

Image 8: Research process

The process can be seen as four individual phases that each correspond with a research question. This division means that it is possible to work on multiple sub-questions simultaneously, except for the fourth one because the end product will be created there.

3.4 Argumentation for Sub-questions

The schematic of the research process gives a general impression of the information needed within each phase of the research and a further specification is necessary. Within this subchapter the sub-questions will be discussed more in-depth with a focus on what information is needed and where that information will be used for.

Sub-question 1: Phase I

"Why do people use the car, how can a behavioural shift be induced, and which transport options are commonly available in Denmark?"

This sub-question is posed in order to create a deeper understanding of the role of the car in people's lives. This understanding is necessary in order to offer people alternatives that are appealing and functional for their day to day activities.

What information is needed?

1. The drivers for people to use the car, both functional as well as psychological.
2. How people can be motivated to change their behaviour and opt for modes of transport other than the car.
3. The alternatives to the car that are commonly available for use to the people in Denmark.

Why is this information important?

1. Identifying barriers that exist for a transition to other modes of transport than the car.
2. Identifying ways to change human transport behaviour.
3. Identifying transport modes that are already commonly adopted and why they do not outperform the car as primary mode of transport.

What will this information be used for?

1. Creating solutions that take away barriers for the adoption of alternative means of transport in favour of the car as well as solutions that reduce the advantages of the car over other modes of transport.
2. Creating solutions that use proven ways of inducing a behavioural shift in humans.
3. The identified transport modes serve as a learning experience from which lessons can be learned about what people see as pros and cons for the various implementations.

Sub-question 2: Phase II & III

"What are the main design considerations for liveable urban space and which best practices for transitioning into car free cities are there?"

This sub-question is posed in order to create a deeper understanding of what a liveable urban space entails, what the best practices of car free design are and how these fit into a liveability perspective. This understanding is necessary to create solutions that create liveable urban spaces, which prioritise people over cars and lie in line with the international liveability agenda.

What information is needed?

1. What a liveable urban space is.
2. How a traditional urban space can become a liveable urban space.
3. Which best practices exist regarding the transition to car fee cities.
4. How planners in the business regions of Aarhus and Nordjylland view the found best practices and what their take on them is.

Why is this information important?

1. Creating a deeper understanding of liveability in a physical urban context.
2. Creating a deeper understanding of the transition to liveable urban spaces.
3. Creating an overview as well as a deeper understanding of solutions that reclaim space from the car that have been proven in a real-world context.
4. In order to have the local context involved in the research it is necessary to have local planners participate in the analysis of different solutions.

What will this information be used for?

1. Creating solutions that fulfil the criteria of liveability in an urban context.
2. Creating solutions that are applicable in existing spaces and guide the transition towards liveability in a tested or proven way.
3. Creating solutions that have proven themselves to be successful in the real world.
4. Creating solutions that work in a local context.

Sub-question 3: Phase IV

"How can the information from previous sub-questions be used to serve as a planning tool?"

This sub-question is posed in order to bring gathered information and analysis together and create a tool that is useful for the transition into car free cities. This sub-question is necessary in order to create a product that is the answer to the main research question.

What information is needed?

1. What tools planners use in their day to day work.
2. All the analysis and important bits of information from previous sub-questions.

Why is this information important?

1. Creating an understanding of the tools that planners use and why they use them.
2. It serves as input for the creation of a planning tool.

What will this information be used for?

1. Creating a tool that planners can use without changing their way of working.
2. Creating a tool for planners that enables a transition into a liveable car free city.

4. Methods and Theories

In order to make it possible to replicate this research using the same approaches, considerations and ideals it is necessary to give insight in the theories of science, used methods and general application of the used theoretical framework. All these topics are discussed within this chapter.

4.1 Methods and Theories of Science

This research is based on pragmatism and utilizes this approach to formulate an answer the research question, create a research design and methodological considerations. Through the use of the pragmatistic paradigm, the use of a mixed method approach is justified. The key elements of the pragmatic world view are visible throughout the whole research process. The pragmatic stand on the characteristics of reality and knowledge can be summed up as the following:

"All knowledge of the world is socially constructed, but some versions of that construction are more likely to match individuals' experiences"
(Morgan 2014, p. 15)

One of the key determinants in a pragmatic research approach is the research question, because the nature of the research questions determines the suitable research design and appropriate mix of methods. In regard to the use of methods there are no sat limits nor restrictions. The only requirement is that the chosen methods have to give the best possible solution to the research question. Hence, there is a strong interplay between the purpose of the research and the used methodological approach (Morgan 2014, p. 17). In this research the mixed methods approach is used since only a combination of both qualitative and quantitative methods will give the best possible answer to a research question that balances social aspects and infrastructural needs.

Especially when looking for answers on sub-question 1 the pragmatic world view is omni present. Quantitative and qualitative data alternate constantly within that chapter. The following philosophical points of pragmatism underlay the conducted research and surface very clearly during the chapter on behavioural change:

"Actions cannot be separated from the situations and contexts in which they occur"
"Actions are linked to consequences in ways that are open to change"
"Actions depend on worldviews that are socially shared sets of beliefs"
(Morgan 2014, p. 2-3)

The research is abductive, because both deductive and inductive elements are present. It is deductive at first, because the thesis draws on theory to seek the most likely explanation for phenomena in the urban environment, but it becomes inductive during the creation of the planning tool during the last chapter as new insights are created to answer the research question. The explanation of the used methods starts on the next page.

4.1.1 Literature review & Document analysis

This project uses literature as the basis for acquiring knowledge about liveability in order to investigate how liveability frameworks can be utilized in a tool for Danish urban planners and municipalities. The literature used is obtained through databases such as Aalborg University Library's PRIMO, but also SCOPUS and Google Scholar, all of which contain numerous scientific databases- and articles. Literature consists of documents from public authorities, on municipal-, regional and national level, private organisations and knowledge institutions. However, web-based literature has also been used and consists of both documents and webpages. Pieces that are mentioned by references in other articles have been prioritised, however, the web-based articles and websites are often published outside the academic society and can thus not be vetted in the same way. In this regard, the focus has been on other articles mentioning them, or if the company or organisation is well known. In general, a literature review is used to investigate and/or summarise the state of research and knowledge in a field (Hammersley 2004), and has thus been used for obtaining state of the art knowledge about liveability and best practises within the field of car-free cities. In order to identify best practises and well-structured cases illustrating car-reducing measures, a thorough search on car-reducing- and abolishing practises was carried out. Since not all articles within the search criteria were used it was not a systematic literature review.

4.1.2 Case study

In this thesis numerous case studies are used in order to find best practises and state of the art design considerations for car-free urban areas and cities. Case studies are useful when investigating and describing qualitative phenomena (Bakogiannis, et al. 2014, p. 43) such as reclaiming space from the car. According to Gary Thomas, a case study is defined as (Thomas 2011, p. 513):

"[…] analyses of persons, events, decisions, periods, projects, policies, institutions, or other systems that are studied holistically by one or more methods. The case that is the subject of the inquiry will be an instance of a class of phenomena that provides an analytical frame—an object—within which the study is conducted, and which the case illuminates and explicates"

The cases used in this project concern cities around the world which have reshaped the city to reduce or ban private cars in areas of the city. Prior to the case selection some criteria were framed in order to find optimal case areas. Cases needed to fulfil a variety of areas and sizes, so both small-scale and large-scale cases- and initiatives are portrayed. They required to have implemented car-reducing initiatives either permanently or temporarily. Furthermore, a summary of the initiative or a statement containing key learnings from the process was a requirement to become a case.

These requirements led to viable cases in various parts of the world. The cases were then sorted according to type of initiative and the cases presenting the most comprehensive and/or detailed process were selected with a priority for cases in close proximity to Europe. The cases serve to illustrate best practises and to provide information that can be used in the creation of a tool for planners. They provide an analytical frame in which planners and municipalities can make decisions about reducing cars. Exploring subjects within urban mobility planning gives insights in applied measures, approaches and policies and furthermore has the potential for comparing practises. Thus, utilizing cases enables the comparison and analysis of practises with their associated urban environment's complexities, culture and context (Bakogiannis, et al. 2014, p. 42-44). Case studies can

therefore be used to investigate in-depth urban relations and be the base or inspiration for changing into car-free cities. The following cases are used:

- Barcelona, Spain
- Dunkirk, France
- Freiburg-Vauban, Germany
- Ghent, Belgium
- Houten, The Netherlands
- Kaohsiung, Taiwan
- Oslo, Norway
- Pontevedra, Spain
- Vitoria-Gasteiz, Spain

Cities can only be considered a case whenever their results are useable for planners to create change in their own municipality through the use of the core principles of used initiatives. Two cities are presented in this report because they are highly unique and give increased insight in the history of car dependency and how things can grow in a different way over time. They are considered examples and not cases, because there are no design considerations that can be deducted from their situation. The cities that serve as examples are:

- Fes el Bali, Morocco
- Zermatt, Switzerland

4.1.3 Interview

Qualitative semi-structured interview sessions have been used to investigate four Danish municipalities' attitude towards car free initiatives and how they view the tool created in this project. The interviews took place over Microsoft Teams and were structured as two video group interviews and two ordinary semi-structured video interviews. Qualitative interviews are useful when in-depth questions about a pre-determined subject are necessary. The fact that it is semi-structured provides the interviewer with the opportunity to ask follow-up questions and thus obtain more elaborate answers (Kvale, Introduction to Interview Research 2007, p. 8-10).

The use of group interviews made it possible to structure the interview as an 'open dialogue' which made the flow of questions and answers more fluid, thus making the setting more informal and the interviewees more relaxed (Kvale 2007, p. 6-7). The group interviews provided more elaborate answers and discussions as well, since two to three planners participated at the same time and engaged in internal discussions, elaboration and information sharing in general. Because of this, the planners had the opportunity to provide information from their respective department or team, while additions to initiatives, processes and/or frameworks were provided from colleagues from other departments with different views and a focus on different aspects. The group interviews had the benefit that the planners could draw on the expertise of each other and thus the answers were more specific and to the point. The interviews were structured with open-ended questions, which give the interviewee the opportunity to answer more directly in relation to their expertise. The specific questions can be seen in (Appendix 36), but the main topics they revolved around are listed on the next page.

- Local context
  The context in the respective municipality was investigated in order to get an idea of what ideals and visions the planners face regarding planning for private cars.
- Tool material
  The interviews furthermore included questions dealing with the sent tool material and the use of this tool in their daily work.
- Presentation of the tool
  Lastly questions about the presentation of the tool were asked, making the planners consider the presented material and what could be beneficial to add and/or remove.

Prior to the interviews, several municipalities in two different business regions of Denmark were scoped in order to find their compatibility. This scoping was done before the corona crisis started and visits to the municipalities were expected. Due to time- and monetary restrictions, only 'Business Region Aarhus' and 'Business Region Northern Jutland' were included in the scope. The two business regions were chosen as well because both regions focus on attracting new citizens by creating interesting jobs, but also by promoting cities within the respective business region. Sustainable mobility and a new image can be supportive of these goals. Because of the thesis focus on the creation of liveability in cities by reclaiming space from cars, the municipalities had to meet two criteria before they passed the scoping. These criteria are listed below.

- The municipalities in the two regions had to have a city of minimum 20.000 inhabitants.
- The municipalities were required to have a city development plan or vision focussed on making the city a better place for its inhabitants and thus having a focus on liveability.

7 municipalities fit the criteria: Aarhus, Aalborg, Randers, Viborg, Hjørring, Frederikshavn. Skanderborg was included as well, on the basis of a well-structured inner-city plan, and the fact that they were just under the inhabitant limit. Of the 7 municipalities, four showed interest in the project and they are listed below.

- Randers
- Hjørring
- Frederikshavn
- Skanderborg

Material the interviewees should review was sent out 3-8 days prior to the interview, which included:

General material

- Reading guide (Appendix 35)
- Interview questions (Appendix 36)

Cases

- Barcelona (Appendix 2)
- Dunkirk (Appendix 5)
- Freiburg-Vauban (Appendix 14)
- Ghent (Appendix 12)
- Houten (Appendix 13)
- Kaohsiung (Appendix 6)
- Oslo (Appendix 8)
- Pontevedra (Appendix 9)
- Vitoria-Gasteiz (Appendix 3)

Initiatives

- Filtered Permeability (Appendix 10)
- Free Public Transportation (Appendix 4)
- Superblocks (Appendix 1)
- Walkable City (Appendix 7)
- Woonerf (Appendix 11)

This way the interviewees had time to prepare and for a substantiated opinion on the subject. The interviews were conducted in the timespan of 45min-1h 30min with 1-3 municipal participants. Post interview, interview notes were sent to the interviewees for confirmation of content and possible correction.

The interviews conducted in this project were held in Danish in order to give the interviewees the possibility to provide more detailed and natural answers than in English. Notes on the interviews can be found in (Appendix 38-41) and they were held on the following dates:

- Randers Municipality on 04th of May 2020 from 10.00-11.30 with three planners (Appendix 40)
- Frederikshavn Municipality on 06th of May 2020 from 14.00-15.00 with one planner (Appendix 38)
- Skanderborg Municipality on 07th of May 2020 from 15.00-15.45 with two planners (Appendix 41)
- Hjørring Municipality on 11th of May 2020 from 14.00-15.00 with one planner (Appendix 39)

The interviews were originally planned as physical workshops with a presentation to give insight in the structure and development of the case- and initiative sheets, but due to the COVID-19 situation at the time of writing this report this was not possible. If the workshops would have been a possibility, planners would have been more involved in the process because they would have been able to gather in greater numbers and discuss the cases in an intermunicipal way to spark more discussion. Furthermore, it is clear that the preparedness of the planners had a significant influence on the video interviews. This could to some extent have been avoided by hosting the workshops, since it is easier for the planners to get information verbally than by spending time to read through cases.

The methods used in this thesis are literature review & Document analysis, case studies and interviews. These methods complement each other in order to answer the research question. Information on the following topics was gathered through the use of literature review: case scoping, psychological factors for car use, design considerations for liveability planning and municipal scoping. The literature review created the base for the case study, with the utilisation of document analysis, providing extensive knowledge of car-reducing initiatives and how to implement these projects successfully. The literature study and document analysis within the framework of case study led to the creation of initiative sheets, which summarise key case goals and findings. The interviews take point of departure in this previous work and utilise experts to investigate if this theoretical tool can be used in the complex landscape of the local municipal contexts. The interviews are also used to improve the tool, by including planners' perspective, attitude and experiences in the creation process.

4.1.4 Graphs and Tables

Graphs and tables are useful tools for conveying a story with data. They have been used extensively in chapter 5 of this thesis, that describes mobility modes currently available in Denmark. In order to make the graphs appealing and to convey the right message, the guidelines of the book "Storytelling with Data: A data visualization guide for business professionals" by Cole Nussbaumer Knaflic has been used. She is a data analyst with more than 10 years of experience in making graphs that convey a message. Places of work range from Google, private equity and the banking sector (Nussbaumer Knaflic, LinkedIn 2020). The main take-aways from her book (Nussbaumer Knaflic 2015) for this report are:

- Use colour sparingly to incorporate pre-attentive attributes in graphs. (page 118)
- Design for the colour-blind, never use shades of red and green. (page 121)
- Use blue as an attention-grabbing colour for positive aspects. (page 121)
- Use orange as an attention-grabbing colour for negative aspects. (page 121)
- Use grey as a base colour, because other colours stand out more against grey than against black. (page 117)
- Use colour consistently across multiple graphs. (page 120)
- Eliminate distractions by avoiding clutter, elements that do not add information to the created visuals. (page 132)
- Avoid the use of pie charts, donut charts, 3D elements and secondary y-axis. (page 62)
- Use line graphs, slope graphs, (stacked) vertical and horizontal bar graphs, scatterplots, tables, heat maps and simple text. (page 36 & 37)
- The principle of continuity often makes the use of a visual y-axis obsolete. (page 79)

The thesis utilises the key takeaways in order to create graphs that represent data in a way that helps the reader understand the main takeaways more easily.

4.2 Used Theories

This research is built on three main theories: The concept of liveability, drivers behind car use and behavioural change through change of habits. Since the concept of liveability and drivers behind car use have been described in the framework of this report (Chapter 2), this section will not repeat the findings but instead continue with elaborating on how they are applied. However, the paragraph on behavioural change through habits does contain a few words on the main concept because the actual more detailed description is placed in the main body in chapter 5.2.

4.2.1 Liveability Concept

This thesis utilises a liveability concept that has been identified in the framework of the project (Chapter 2). One of the key takeaways is, that liveability is a concept that includes several aspects of human life, and it requires holistic planning that takes all the six identified liveability aspects into account. Because of the concept is so intangible, it can be challenging to frame a planning strategy that accounts for all aspects. An excessive use of cars is seen as one of the main causes for multiple challenges regarding liveability in cities. This thesis therefore takes point of departure in the six pillars of liveability and focusses on the reduction of cars in urban areas as a key driver for liveable urban areas. Creating urban liveability can thus be seen as the desired end goal which can be reached by the restructuring of urban areas to reduce the impact of the car and prioritize citizens, among other things not in the scope of this thesis. Therefore, the previous defined concept of liveability is used to create a deeper and holistic understanding of what aspects need to be accounted for or improved in order to shape a liveable space. This understanding is necessary for choosing and reviewing proven solutions that are said to create liveable urban spaces by prioritising people over cars. The concept of liveability explained in the framework is used throughout the report as a recurring common theme and as an evaluation tool to assess initiatives' impact on local liveability.

4.2.2 Drivers for Car Use

The drivers for car use have been identified in the analysis (Chapter 5). Like the various aspects of liveability, the drivers behind car dependency are manifold. They consist of physical aspects such as infrastructural characteristics, but also social and psychological factors such as being able to have conversations, create emotional connections or simply take a break from a stressful world. The drivers for car use are used to understand why people continue to cling to their cars, even though this mean of transport might lock them into daily traffic and the negative environmental impacts of car use are well known. The term 'structural stories' has provided further explanation about why people choose to drive a car. The term is used for generally accepted arguments that people use which are reproduced in a common way throughout society. The stories evident in society can thus be used to obtain a baseline for a framework aims to challenge or change the perception of the car in everyday life. If the perceptions and therefore structural stories, evident in society have been identified, a framework for change can be created. The drivers for car use can thus be utilised to obtain a baseline for behavioural change. The theories behind drivers for car use make it evident that the current car dependent regime is highly grounded and linked to individual behavioural choices as well as societal trends. This construct can therefore not be changed overnight and encompassing solutions that address all pillars of car dependency are required to bring about change.

4.2.3 Behavioural Change

Based on the theory of drivers behind car use and the manifold of the determents locking people into car dependency, a detour into the social science is necessary in order to understand habitual behaviour. Here, findings on habits from the pragmatist John Dewey are used to explain travel behaviour. The theory of behavioural change is investigated in chapter 5. It explains how behaviour is shaped through the creation of habits both individually and in society. One of the theoretical key takeaways is, that habits are not fixed and can therefore change when affected. In our case, behaviour is investigated in relation to car-use and mobility in general in order to understand how change can be induced. Car use is held in place by various habits that have both physical and psychological manifestation in the choices of people. This meaning that either infrastructure or social aspects can determine why people use a car. Therefore, it is not sufficient to only target infrastructural changes when inducing change. Instead the habits of people and the systems keeping the habits in
place need to be addressed as well in order to induce a change in mobility practices. The understanding of habits influences the evaluation of suitable cases and initiatives for the final planning tool.

In order to create more liveable urban areas, it is clear that it is important to not only look into the structural and physical aspects of an urban area, but also investigate the reasons why people conduct themselves the way they do. Identifying motives and/or arguments for the use of cars creates opportunities for a planning strategy that induces change through affecting people's habits.

5. Car use in Denmark

The focus of this chapter lies with answering sub-question 1, which reads as follows:

"Why do people use the car, how can a behavioural shift be induced, and which transport options are commonly available in Denmark?"

In the introduction of this report the utilitarian and rational factors for car usage have been discussed, however there are also cultural and psychological reasons for using the car as a primary means of transport. Within this chapter it is important to enhance the understanding of all these factors for car use, as well as how a behavioural shift can effectively be induced and which alternatives for the car are commonly available in Denmark.

5.1 Psychological Reasons for Car Use

Within automobility studies, the social sciences had been excluded for most of the existence of the field. Since the turn of the millennium more and more scientist have dedicated themselves to the field and have produced a body of work that should function as input for policy makers, but is often overlooked by the target audience (Jeekel 2014, p. 102) (Schwanen and Lucas, Understanding Auto Motives 2011, p. 21). The social domain of car mobility choices and transport patterns consists of 5 distinct fields of study. These fields are (Jeekel 2014, p. 98 - 99):

- Mobility choices
- Cultural and psychological drivers for car use
- Car comfort, convenience, consumption and health problems
- The issue of time and car use
- The car as a central driver towards modern society

In the introduction of this report four of these pillars have already been discussed. The mobility choices people make, the convenience of the car, the issue of time and car usage and the car as a driver for the physical development were an integral part of this. The only pillar that still needs to be discussed is the one concerning cultural and psychological drivers for car use. This sub-chapter focusses on the exploration of this pillar of mobility studies.

Within the cultural and psychological studies regarding car use, it has become apparent that the car means more to most people than just a means of getting from one point to another. Many people own a car because they like the look or they induce feelings of power, skill and freedom. An expensive or nice car is also seen as an indicator for success in life by many people. For men especially, a car is a very important instrument of self-actualisation and therefore gives them strong feelings of fulfilment (Jeekel 2014, p. 98).

An emotional connection to the car can find its roots in early childhood. When children get taken on car rides which they enjoy, then they get 'wired' or 'imprinted' to favour the use of automobility throughout their life. Usually for children this is a meaningful social practice with their parents that in part constitutes the social identity. The same can be true for public transport, biking and walking if those modes of transport were most regularly used during childhood. The predisposition that emerges can be a huge barrier for change that is so deeply ingrained in a person that it is hard for policy makers to undo in later stages of life (Schwanen and Lucas, Understanding Auto Motives 2011, p. 25 - 26). Just like children, adults have meaningful social interaction within the car as well. Car trips build bonds, both through verbal as well as non-verbal communication by collectively navigating the streets. Co-workers extend their work space and can discuss work while commuting, parents educate their children and other co-travellers have thoughtful conversations (Schwanen and Lucas, Understanding Auto Motives 2011, p. 26).

As illustrated by the fact that a car ride can be a meaningful social interaction, a car entails much more than just a means of transport. It is a place of comfort in which people practice different kinds of activities. Women in particular use their car to relax, unwind and prepare for activities that take place at their destination. It provides a temporary break from demands of other people and is a place to de-stress. Another feature that is widely used is the ability to create a personal soundscape within the car to make the trip as comfortable as possible. This makes the car like a living room on wheels and an object that people inhabit (Schwanen and Lucas, Understanding Auto Motives 2011, p. 26) (Kent 2014, p. 104 & 111).

Freedom plays a major role in car preference as well. People perceive greater freedom when they can change the combination of streets which are navigated in order to adapt to the situation on the road. Automobility is ultimate freedom in this regard, because it offers the ability to move independently, without time restrictions and to any location desired. It also offers an owned space that is personal, personalized and can provide a time-out from social interaction. This provides peace and offers a chance to recharge in-between activities like work and caring for a family (Kent 2014, p. 110)

The term 'structural stories' emerged in research that focussed on everyday life and the challenges of changing mobility practices. Structural stories are recurring narratives that people use to rationalise the way they practice mobility. Interestingly enough, structural stories do not differ a lot between users of cars, public transport and bikes. This is due to the fact that time pressure and risks have become inherent parts of daily life that people have learned to navigate. Some examples of the most frequently used structural stories are (Freudendal-Pedersen 2020, p. 5):

- "When one has children, one needs a car"
- "One cannot rely on trains; they are always delayed"
- "It is too dangerous to cycle because of all the cars"

These statements are all very broad and general, more focussed on a group feeling than personal responsibility and ownership. By creating a feeling of community, structural stories help to shape general assumptions about mobility in a way that they are perceived as the objective truth and thereby maintain specific mobility practices. In this sense society creates structures that are ingrained in an individual's conscience. When an individual must act, these structures are automatically recalled and form the basis for the actions that follow. This deep entanglement of structural stories maintains the desire and need for automobility in (Freudendal-Pedersen 2020, p. 5).

All these different factors culminate in the fact that cars can provide unique possibilities that stimulate the psyche that are not easily replicated by other modes of transport (Schwanen and Lucas, Understanding Auto Motives 2011, p. 26). These possibilities and attachments heavily influence the choices people make and therefore it is not always the process of reasoning that dictates the choice of transport. The choice therefore is not solely made on the base of saving time, but also on the desire of expressing oneself, being comfortable and appealing to social norms (Kent 2014, p. 105). The absence of reasoning might also lie within human biology as it is customary to lower mental effort by creating a habit and following it without question (Schwanen and Lucas, Understanding Auto Motives 2011, p. 28).

It is important to understand the thought process and values of people, because most transport policies are still constructed on the base of rational motives instead of the less quantifiable ones. Commuters are however unlikely to abandon the comfort of their cars for a marginal time saving (Kent 2014, p. 113). As Kent notes in her research:

"To stand for 35 min on a crowded train or bus twice daily, or to ride a bike in the wind and rain, is, for some people at least, physically unpleasant. And to willingly endure such discomfort threatens deeply embedded cultural notions of freedom and autonomy."
(Kent 2014, p. 113)

Deeper values of automobility need to be included in transport planning to balance the rational values like time saving on which current policies are most often based. This is necessary to provide a suitable alternative to the car (Kent 2014, p. 113).

Another implication for policy makers is urban density within a city. In heavily sprawled areas a "no car city" is currently a utopian vision. It is important to recognize this and accept that the car is there to stay for a prolonged period of time (Freund and Martin 2009, p. 477). This has implications for transport policy and results in planning that provides alternative infrastructure that incites people to drive less. Revoking the car from the private realm is an alternative in this situation and car sharing services can fill this role. There should also be a drive for more sustainable fuels and a better integration between the car and alternative transport modes. Viewing transport as either car-based or alternative is restricting the creation of an integral overview of the way people practice mobility and how these practices can be changed. In this situation the car should not be demonised but rather 'tamed' in a future scenario (Kent 2014, p. 113 - 114).

The car supports values that a lot of people value in life. These positive effects offset the congestion, environmental impact, health concerns and cost of a car for many. It represents different ways of parenting, working, socialising and caring for others. The shift to alternative transport is experienced by many as an attack on the well rooted notions of entitlement and freedom as it is on their time (Kent 2014, p. 114). Results of social research are difficult to incorporate into policy however and therefore it is important to create knowhow on the way professionals can include social aspects into their planning and policies. According to Jeekel, seven interrelated aspects have to be incorporated in order to create inclusive policies which make use of the social sciences. These seven elements are (Jeekel 2014, p. 102):

1. Reachability of all locations for non-car households.
2. Poorer households have to be able to finance their mobility needs.
3. Planning of new services so they are reachable with all modes of transport.
4. Accessibility strategies have to shift the focus from travel time to real access issues.
5. Introducing normative car use policies, not all car usage is acceptable or necessary.
6. Including ethics within mobility strategies in order to provide 'good' mobility.
7. Addressing the issues of time scarcity and reducing travel related stress within mobility policy.

5.1.1 Summary of Chapter 5.1

This subchapter summarizes the most important information of entire chapter 4.1.

The general assumption that people select their mode of transport on purely rational notions has been debunked in several studies. The importance of the car therefore stretches beyond time saving and efficiency. It is important to grasp the values the car supports in people's everyday life in order to offer suitable alternative scenarios. The car represents the way people parent, work, socialise and care for others. It appeals to deep rooted notions of freedom and entitlement. The main psychological factors for car usage are:

- Freedom and flexibility of travel.
- Personalisation of the car, through both looks and inner soundscape.
- Having meaningful social interaction with co-workers, relatives or friends.
- Providing a time out from social interaction.
- De-stress and recharge between activities.
- Comfort during travel.
- Showing status.
- Ingrained societal structures.

Giving these psychological aspects a place in planning and policy making has proven itself to be difficult. The social sciences are therefore often omitted by planners and policy makers. In order to use the social sciences in policy making, seven interrelated aspects have to be incorporated. These elements are listed below.

1. Reachability of all locations for non-car households.
2. Poorer households have to be able to finance their mobility needs.
3. Planning of new services so they are reachable with all modes of transport.
4. Accessibility strategies have to shift the focus from travel time to real access issues.
5. Introducing normative car use policies, not all car usage is acceptable or necessary.
6. Including ethics within mobility strategies in order to provide 'good' mobility.
7. Addressing the issues of time scarcity and reducing travel related stress within mobility policy.

5.2 Behavioural Change

All five pillars of car usage- and dependency have been explored in this report, discussing both practical considerations and sociological drivers for car use. This chapter builds on the psychological facet, discussed in the previous chapter. It was established that the dependency on cars reaches way beyond practical issues like convenience, time savings and efficiency, thereby stressing the importance of including a social and psychological view on people's preference to use the car.

The most common ideas and initiatives that aim to create a shift from car centred travel behaviour towards more sustainable means of transport take point of departure in the basic assumption that this shift will take place as long as the correct infrastructure is in place. Hence, strategies are mainly built around short distances, access to public transport and suitable walking and biking infrastructure (Schwanen, Banister and Anable 2012, p. 529). These initiatives do not fully address the reasons behind car dependency, because they omit the psychological factors for car use. More needs to be done in order to change people's relationship and perception of cars in urban areas. Therefore, further information on how citizens get stuck in the habit of being car dependent and how changes in already existing habitual structures can take place is of great value for planners that reallocate urban public space.

The philosopher and pragmatist John Dewey (1859-1952) worked in-depth with human habits and the change thereof (Field n.d.). This chapter will take point of departure in Dewey's notion of human habits and how to change them, followed by recommendations for future initiatives.

5.2.1 Human habits explained

A habit is not just an automated human behaviour that repeats itself. It is an active force with outcomes, which are not pre-determined by repetition of previous actions. Habits should be understood as generative tendencies and active self-preserving inclinations (Schwanen, Banister and Anable 2012, p. 526), (Dewey 1922, p. 42). These characteristics of habits are very important for people working with travel behaviour patterns, since they underline that already established habitual behaviour will not easily or naturally disappear.

Habits arise from the relations between people and the environment they navigate. They are ways of incorporating material infrastructure, objects, tools and other people into an individual's daily life (Dewey 1922, p. 17). Thus, a manifestation of the body-mind-world relations (Schwanen, Banister and Anable 2012, p. 526), (Schwanen 2012). It has to be noted, that the body-mind-world assemblage is shaped by the institutions in society (Schwanen, Banister and Anable 2012, p. 526, p. 527). This means that even though planners wish to change individuals travel habits, they need to look outside the box and investigate the surrounding environment, overall local context and the interplay between individuals and the environment they navigate. Nevertheless, habits do create some sort of automated response system (Dewey 1922, p. 24). These parts of habits set up a physiologically imprinted mechanism for an action, which sets in spontaneously whenever a certain impulse is given (Schwanen, Banister and Anable 2012, p. 526). An example of this imprinted mechanism could be the rapid action to hit the brake of a car before hitting something.
Since many habits are entailed with intelligence, they are often novel and creative as well. An example of this is a cyclist skilfully managing his/her way through hectic urban traffic (Schwanen, Banister and Anable 2012, p. 526).

The overall characteristics of habits have been identified, but it is important to know that there are different forms of habits. There is a distinction between personal habits and collective habits in social groups. The collective habits for instance are predominant in social institutions[1]. A person's individual habits arise in the context that is defined by the institutions and their collective habits (Schwanen, Banister and Anable 2012, p. 527).

The tricky part about habits is that once a person converted an action into a habit, the habit will stay even though it is not visible or apparent for the outside world all the time. Habits are not always visible, but they will stay as underlying forces, which means they can constantly be triggered at later points in time (Dewey 1922, p. 37). This means that habits that a person obtained during childhood can be brought back later in life (Schwanen, Banister and Anable 2012, p. 526). This point is important for planning new initiatives within car reduction and liveability. Changes can be facilitated through nudging children and young adults in the desired direction. Although it is a long process, this can possibly affect change through positive payoffs when they grow older. For instance, if children learn to ride the bike and are familiar with physical activity in general, there is a good change they might continue an active lifestyle later on or take the habit with them in other environmental settings (Schwanen 2013). Based on the above-mentioned characteristics of habits, Schwanen et al. summarize a habit to be:

> "(..) *a habit is an emergent property of a body-mind-world assemblage – something that is fabricated out and ties together the fluid and continuously changing ensembles of limbs, muscles, sensory organs, the brain, neurochemical processes within the corporeal body, artefacts (including transport technologies), infrastructures, bodies of other human beings, rules, procedures, ideas, norms and other agents encountered as part of the flows and rhythms of everyday life."*
> (Schwanen, Banister and Anable 2012, p. 526)

This definition makes it sound very difficult to get rid of undesired habits, but it is important to understand that even though unwanted habits might not disappear, they can be reorganized and changed to have more desirable outcomes.

5.2.2 Changing Habits of Travel Behaviour

Habits can be changed and reorganized through interaction with each other. In these interactions conflicts between different habits are the key source for social change. These can be conflicts between personal as well as personal and institutional habits. When outside institutions challenge a person's individual habits, this person will begin to reflect on the current situation. These new reflective thoughts can potentially evolve into initiating actions, which later forces current habits to be reorganized and change (Schwanen, Banister and Anable 2012, p. 526). Institutions can initiate change on the individual level and individuals can initiate processes that influence the overall institutions.

The power to shape new institutions and customs in the socio-technical world of urban transport is placed amongst different stakeholders: the transport industry, politicians, media, consultancies, lobby organisations etc. (Schwanen, Banister and Anable 2012, p. 528). It has to be noted that a change in institutions and customs will not automatically result in a change of a person's habits. Some people simply do not respond to outside changes. For instance, if they personally wish to resist the attempt of change made by the government or

[1] Social institutions are assemblies of people, ideas, artefacts and infrastructure (Schwanen, Banister and Anable 2012, p. 527)

municipalities, or because their travel habits have become too instinctive (Schwanen, Banister and Anable 2012, p. 527).

Travel habits are more likely to change if the overall agenda of behavioural change is focussed on a systemic change, where the overall socio-technical[2] system is thoroughly rearranged. Changes made solely at the material infrastructural level and pricing of cars will be less effective in changing people's habits, than holistic programs which target the institutions and their customs (Schwanen, Banister and Anable 2012, p. 527).

5.2.3 Implications for New Mobility Initiatives

As previously stated, the idea of creating a completely car-free world is a utopian vision in the foreseeable future, since there will be many areas and situations which call for the use of cars. Therefore, sudden fundamental changes should not be the way forward but instead a strategy which addresses change in a gradually way based on spontaneity in habits (Schwanen, Banister and Anable 2012, p. 529).

Initiatives should also focus on the younger generations, since they have the possibility of affecting future habits and change. Therefore, initiatives promoting active mobility at a young age are essential in creating the desired habits. Having bad experiences concerning infrastructure at a young age can prevent the establishment of active transport habits (Schwanen, Banister and Anable 2012, p. 529).

An extension in the use of stakeholders beyond private persons is needed to change the focus on the car-centric system. The organizations and institutions, who hold the power to change the current social institutions, need to be part of the process in order for change to happen. This means that stakeholders like politicians, the transport industry, consultancies and the media need to be addressed in these initiatives and the stakeholders need to work towards the same goal. Signals, like governmental information and press releases, send to the general public need to be consistent and comprehensible to achieve an effective outcome (Schwanen, Banister and Anable 2012, p. 528).

The cultural meaning and associations of the car like freedom, power and control need to be rearranged in order to achieve habitual change and thus a shift in travel behaviour (Schwanen, Banister and Anable 2012, p. 528). This means that new car-reducing initiatives need to have a wide range of targets. It is not enough to solely work with a temporary price reduction in public transport or information campaigns on alternative means of transport. Instead these measures need to be part of wider programs, including the infrastructure for alternative means of transport (Schwanen, Banister and Anable 2012, p. 528). A solution is targeting the image of the car in order to reform people's moral discourses. The image of the car can be changed from an object of freedom into an embodiment of being trapped. Cars are trapping people in stressful lifestyles, social expectations and a dependency on transport that is mostly powered by fossil fuels. Furthermore, the focus on car dependent behaviour results in an immobilization of people without cars (Schwanen, Banister and Anable 2012, p. 528). Starting discussions and distributing information emphasizing cars negative effects on citizen liveability, especially on 'health and safety', and how much liveability could increase if public space is redistributed to the people instead of cars could change people's perception of cars as well as their image.

This change should not be forced from the top down, although governments can still facilitate the change of a socio-technical regime. They can for instance ensure adequate

[2] The socio-technical systems include infrastructure, technology, knowledge, laws and regulation, user practices and culture (Schwanen, Banister and Anable 2012, p. 527).

accessibility to alternative modes of transport, increase the prices connected to private cars and enrol as many stakeholders as possible into the transition (Schwanen, Banister and Anable 2012, p. 528).

Since a perfect process of changing habits and travel behaviour is not yet developed, it is useful to draw on practical examples and start experimenting to find successful processes and initiatives. Participatory methods are useful in this process in order to enhance novel and creative ways of restructuring travel habits. These novelties should be tested with citizens and other stakeholders alike (Schwanen, Banister and Anable 2012, p. 530).

Primarily based on Dewey's view of habits and behavioural change through habits, Schwan et al. suggest a new and more comprehensive and systematic approach towards new initiatives to reduce car-impact (Schwanen, Banister and Anable 2012, p. 530):

- Attention has to be given to the appearance and internal reorganization of habits as well as the breaking of old habits.
- Focus has to be distributed equally across habitual facets of the body, mind and world.
- Initiatives should work with several measures. These should include social as well as material measures and target the field of behaviour as well as technology.
- Include all relevant stakeholders and not 'just' the users or citizens. Signals regarding the desired practice should be coherent amongst stakeholders.

5.2.4 Summary of Chapter 5.2

This subchapter summarizes the most important information of entire chapter 4.2.

It is important to understand that habits are not just automated behaviour created through repetition. They arise from the relationship between people and the environment they navigate. Habits are ways of incorporating and using material infrastructure, objects, tools and other people in individuals' daily lives. They can change if interaction or conflict with other habits occurs. A change on institutional level might influence personal habits and vice versa. The power to change institutions is distributed between all stakeholders.

Travel habits are more likely to change if the overall agenda of behavioural change is embedded in a systemic change, where the overall socio-technical system is rearranged. This rearrangement can be induced by:

- Utilizing strategies which address change in a gradual way.
- Addressing more stakeholders than solely citizens, since more stakeholders hold the power to change institutions. Signals send out to stakeholders need to be internally consistent and comprehensible.
- Focussing on forming desired habits at a young age, because habits can be re-called and re-activated.
- Addressing all facets of car dependency by using a wider range of targets.
- Avoiding a forced change in the socio technical regime through a top-down approach. Authorities, such as municipalities, have a more facilitating role in the transition into a new regime.
- Drawing on experience from practical examples. In the development process participatory methods are useful for creating novel and creative initiatives.

5.3 Mobility in Denmark

The expected development of car usage in the world has been discussed in the introduction of this report. It is important to frame this in a more local context in order to provide insights that are tailored for use by municipalities in Denmark. This chapter therefore focusses on the use of automobility and alternative modes of transport in Denmark. Where necessary, the statistics are compared to European averages in order to offer a perspective on the problem and its respective progress in Denmark. There is also a description of active mobility in this chapter, which explores the health benefits of active mobility as well as its use in Denmark.

In order to convey mobility trends and tendencies, the graphs have been colourised in blue and orange colours to be able to quickly get an overview of the subject. The reasoning behind this can be found in chapter 4.1, which explains the methods used in this research.

Desirable Trend Undesirable Trend

5.3.1 Danish Travel Behaviour

The Centre for Transport Analytics of DTU releases an annual analysis on the travel behaviour of Danes. It shows that in 2018 a Dane spend 56 minutes a day traveling from one destination to another on average. More than half of this time is spent in cars: 30,4 min on average (Christiansen and Baescu, TU årsrapport for Danmark 2018 2019, p. 6). Figure 1 shows a comparison to other transport modes.

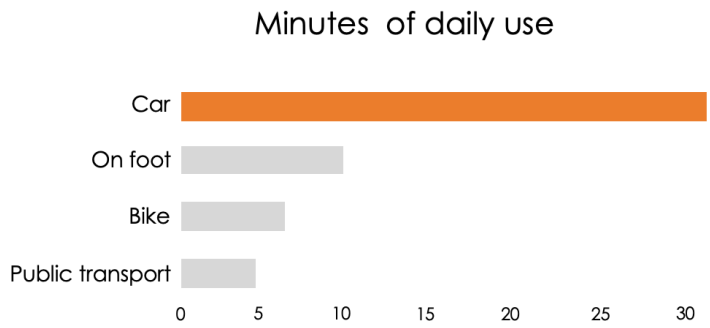

Figure 1: Average time spent daily per transport mode (Christiansen and Baescu, TU årsrapport for Danmark 2018 2019, p. 6)

The average daily movement of Danes covers 38 km in distance and is spread over 2.8 trips (Christiansen and Baescu, TU årsrapport for Danmark 2018 2019, p. 5). The most predominant drivers for these trips are commuting, running errands and leisure time (Christiansen and Baescu, TU årsrapport for Danmark 2018 2019, p. 12). The purpose of the trips is visible in Figure 2 on the next page.

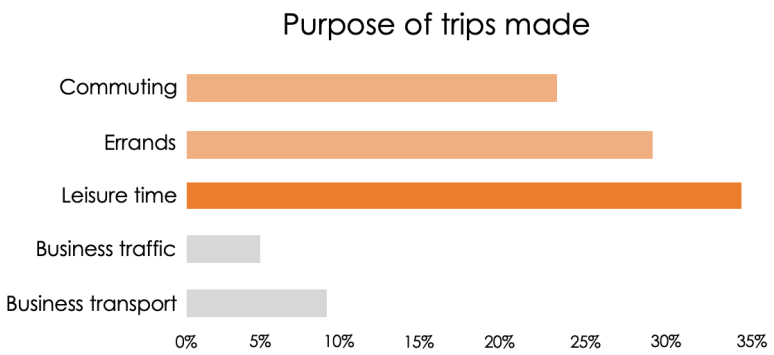

Figure 2: Purpose of trips made in Denmark (Christiansen and Baescu, TU årsrapport for Danmark 2018 2019, p. 7)

It is clear that Danes spend most of their travel time in a car and the reasons why they make their trips have been identified. It is not yet clear however how the use of transport compares to the rest of Europe. Figure 3 shows the comparison of the modal share between Denmark and the European Union.

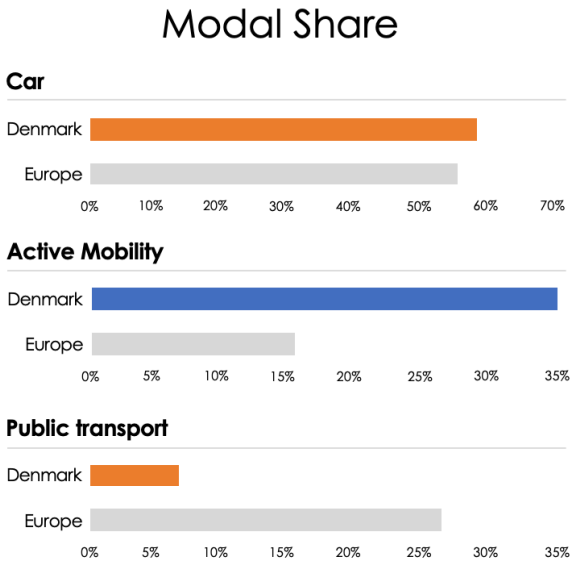

Figure 3: Modal share comparison between Denmark and the EU (Christiansen and Baescu, TU årsrapport for Danmark 2018 2019, p. 6) (Fiorello, et al. 2016, p. 1107)

Danes make 59% of all their trips by car compared to the 56% average of the European Union. This percentage highlights the central role of the car in people's everyday life. Active mobility accounts for 35% of the transportation in Denmark, which is significantly higher than the 16% average in the European Union. Only 7% of the trips in Denmark were carried out by public transport, which pales in comparison to the 27% average in the European Union (Christiansen and Baescu, TU årsrapport for Danmark 2018 2019, p. 6) (Fiorello, et al. 2016, p. 1107). Denmark prides itself in its bike culture but judging from the average numbers it seems likely that most of the people that make a switch to active mobility previously used public transport instead of the car.

5.3.2 Cars in Denmark

Statistics have proven that the car satisfies a significant part of the transportation need in Denmark. However, it is not yet clear how many cars there are within the country. The number of cars in Denmark has been increasing steadily during the last decades. In 2020 the total number climbed to a total of 2.600.000 cars (Statistics Denmark 2020, BIL10). With a population of 5.820.000 (Statistics Denmark 2020) this equates to 1 car per 2.2 residents. The number of cars is predicted to grow even further to an approximate total of 2.850.000 cars by 2023 (Danmarks Statistik 2019). Figure 4 shows the number of cars in Denmark throughout the years.

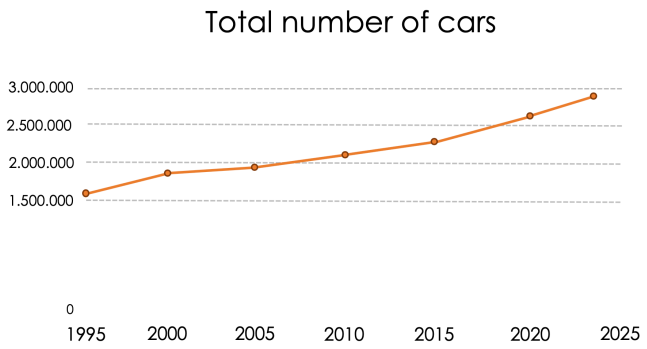

Figure 4: The total number of cars in Denmark throughout the years (Statistics Denmark 2020, BIL10)

Newly registered vehicles are the reason why the number of cars in Denmark grows. Since 2013 the peak of new petrol car sales has been reached and the sales thereof are diminishing. The sales of electric vehicles on the other hand is growing exponentially, although it still represents a marginal part of the total sales volume. The trend in newly registered cars per year divided in the main fuel categories is visible in Figure 5.

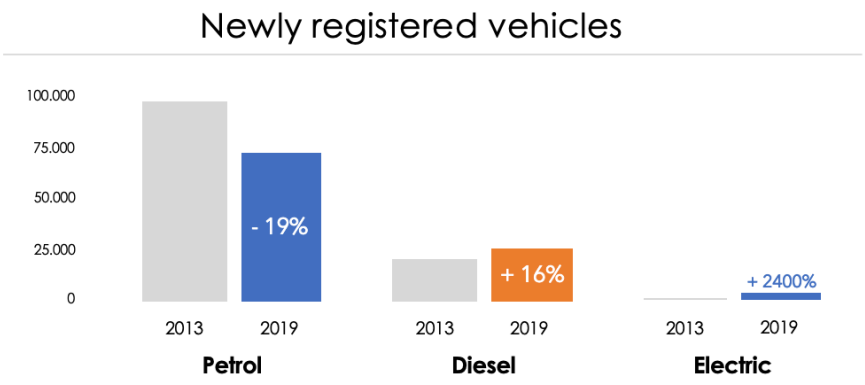

Figure 5: Newly registered vehicles in one year per fuel type (Statistics Denmark 2020, BIL51)

All these vehicles are owned by people, but vehicle ownership is not distributed equally throughout the country. In the capital and Aarhus region the car ownership is between 30 – 50% while rural municipalities surrounding the bigger cities register car ownership rates of around 80% (Danmarks Statistik 2019). In general, 61% of the families in Denmark own a car. This percentage can be split in families that own one car (44%) and families which own two cars (17%). Families that own multiple cars show a lot of similarities. They usually have

a bigger budget, are couples with children, live in single-family houses, work in leading positions and live in towns with less than 2.000 citizens or the countryside. There is also an archetype for families that are not likely to own a car. They usually: have a small budget, are single households without children, live in flats, might be on welfare and live in the capital area or cities with more than 100.000 citizens (Danmarks Statistik 2019).

In order to put this numbers of car ownership by families into perspective it is necessary to compare them to the average cars per household in the European Union. Denmark has a relatively low number of cars per household for a European country. This is visible in Figure 6.

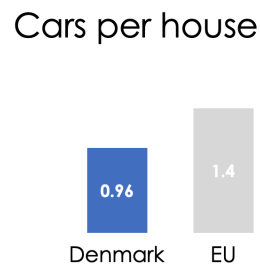

Figure 6: Cars per household in Denmark and EU

(Fiorello, et al. 2016, p. 1106)

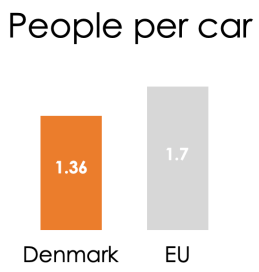

Figure 7: People per car in Denmark and EU

(Fiorello, et al. 2016, p. 1108)

Because there are relatively few cars per household it would be logical to assume that on average there are more occupants per car in Denmark. This has proven to be wrong however and is visible in Figure 7. The surprisingly low occupancy rate provides opportunities for car sharing services. In order to coordinate car rides with multiple people it is necessary to understand the purpose of the trips made by car more deeply. This purpose is visible in Figure 8.

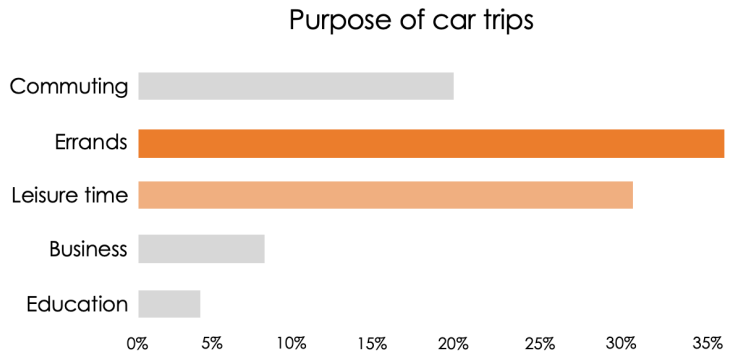

Figure 8: Purpose of car trips by Danes (Christiansen and Baescu, TU årsrapport for Danmark 2018 2019, p. 14)

The majority of car trips are made for errands and leisure time. These are often short trips or quality time with family and friends. It seems logical that most of the time these trips are not suitable for car sharing. Commuting, business trips and trips to educational facilities are all activities that provide opportunities for sharing services, however these trips account for only 32% of the total movements made by car. On average a Dane spends 30 minutes a day in their car and travels 29 kilometres during that time (Christiansen and Baescu 2019, p. 6).

5.3.3 Cycling in Denmark

Denmark is known for having proper bicycle infrastructure and citizens who are willing to bike all year around, which makes biking an important part of Danish everyday life (Ministry of Foreign Affairs of Denmark n.d.). Further underlining the image of Denmark as a bike nation is its capital city. Copenhagen was repeatedly evaluated as one of the most bicycle friendly cities worldwide. In 2015, 2017 and 2019, Copenhagen was labelled the most bike-friendly city worldwide (Copenhagenize 2019). The majority of the population, 66%, is in possession of a bicycle, which they use for 15% of all trips (Christiansen and Baescu 2019, p. 5 - 6). The purpose of these bike trips is visible in Figure 9.

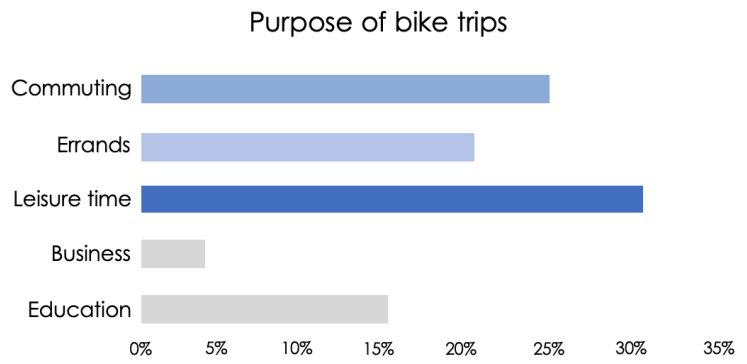

Figure 9: Purpose of bike trips by Danes (Christiansen and Baescu, TU årsrapport for Danmark 2018 2019, p. 14)

These bike trips are usually not very long and 77% of the Danish bike movements do not exceed 10 kilometres in distance (Christiansen and Baescu 2019, p. 9). On average Danes bike 1,3 kilometres a day and spend 5,5 minutes doing this (Christiansen and Baescu 2019, p. 6).

There is a strong correlation between bike use and age. Young people between 20-30 years old bike most kilometres, while the number of kilometres biked decreases with an increase of age. Students bike the most, while people in early retirement bike the fewest kilometres (DTU 2018, p. 1). With the current rise of e-bikes these numbers might change, because it becomes easier to bike for people who are not as physically fit.

Deviations in numbers of active mobility occur throughout the year, because people are exposed to weather conditions. The seasons create fluctuations in the number of bike trips throughout the year. Usually the cyclist count drops during the winter as well as a monthly decrease in July, due to the Danish summer holiday. The highest number of cyclists is recorded during June and September (DTU 2018, p. 1).

5.3.4 Walking in Denmark

Walking is used for relatively short trips by the Danes, 80% of the trips made on foot do not exceed 4 kilometres. Half of them does not even exceed 2 kilometres (Christiansen and Baescu 2019, p. 9). The purpose of these trips is visible in Figure 10 on the next page.

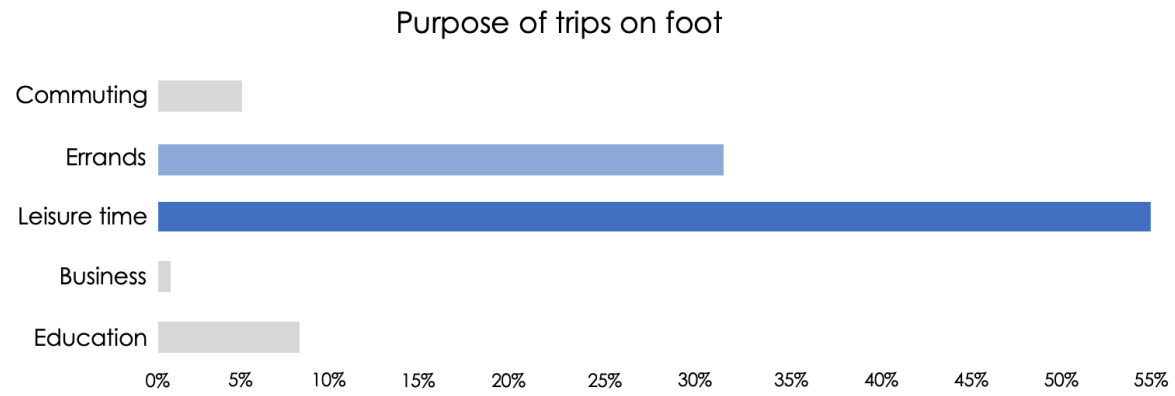

Figure 10: Purpose of trips on foot by Danes (Christiansen and Baescu, TU årsrapport for Danmark 2018 2019, p. 14)

For these trips a Dane walks 0,8 kilometres on average and spends 10 minutes doing it (Christiansen and Baescu 2019, p. 6).

5.3.5 Active Mobility and Public Health

In order to discuss active mobility in a more in-depth way it is necessary to create an unambiguous understanding of the concept. Active mobility, also called active travel or active transport, comprises all kinds of mobility powered by human strength. Most commonly these terms refer to walking and biking, but they also include mobility modes like inline skating, skate boarding, skiing, running and more (Hunkin and Krell, Promoting Active Modes of Transport - A Policy Brief from the Policy Learning Platform on Low-carbon economy 2019, p. 2). Another thing the different types of active mobility share is the direct contact with the environment, which the practitioners have. This means they are influenced by the surrounding infrastructure and various environmental factors like local weather conditions, air- and noise pollution (Muhs and Clifton 2016, p. 147 - 148).

Now the meaning of the term active mobility is clear it is possible to delve into the societal benefits of it. Active mobility is associated with various societal benefits in regard to public health, environment, quality of life in cities and relieving congestion. Because users are active it has a positive influence on frequent user's health. More and more people become aware of these health benefits and it can induce them to leave other modes of mobility in favour of active mobility. Therefore, it holds the potential to reduce car usage through a modal shift and thereby ease congestion problems since bikes and pedestrians consume less space. Lastly, less cars on the roads results in less air and noise pollution, reduction in energy consumption, less greenhouse gas emission and an increase in road safety (Hunkin and Krell, Promoting Active Modes of Transport - A Policy Brief from the Policy Learning Platform on Low-carbon economy 2019, p. 2 - 3).

The health benefits that active mobility offers hold the potential to create a modal shift but are harder to grasp and quantify than the other benefits that active mobility provides. It is necessary to explore the health benefits in order to create greater insight into the ways a modal shift can be induced. Denmark views citizen health as something that is constituted by: people's living- and working conditions, the surrounding physical environment and behavioural risk factors. (OECD/European Observatory on Health Systems and Policies 2017, p. 4) Especially the behavioural risk factors are a major public health issue amongst the Danish population, because they are estimated to be accountable for two out of five deaths. Part of these risk factors is low physical activity which leads to 2% of all deaths in Denmark on a yearly basis (OECD/European Observatory on Health Systems and Policies 2019, p. 7). The World Health Organization (WHO) defines physical activity as follows (WHO 2018):

"(…) any bodily movement produced by skeletal muscles that requires energy expenditure – including activities undertaken while working, playing, carrying out household chores, travelling, and engaging in recreational pursuits"

It has to be noted that the definition of 'physical activity' is not the same as 'exercise'. Exercise is seen as a subcategory of physical activity which covers planned and structured movements with the goal of improving or maintaining a person's physical fitness (WHO 2018).

An active person has better muscles fitness and cardiorespiratory, healthier bones and overall functional health compared to an inactive person. Physical activity reduces the chance of getting diabetes, cancer, depression, hypertension, cardiovascular diseases, chronic lung diseases, impaired mental health and strokes as well (Mueller, et al. 2015) (WHO n.d.). Furthermore, the chances of falling and sustaining fractures will be reduced. Last but

not least physical activity is fundamental to achieve a good energy balance and control weight (WHO 2018).

The World Health Organization (WHO) has written a guideline on the adequate level of physical activity in order to have no increased risk in getting diseases due to inactivity. The guideline is called "Global Recommendations on Physical Activity for Health". It distinguishes between moderate and vigorous intensity physical activity. Moderate activity concerns leisurely activities like walking, cycling and casual sports, while vigorous activity concerns high intensity sports (WHO n.d.). The world health organization recommends (WHO 2018):

- Between the ages of 5 and 17 years old, any kind of physical activity for 60 minutes a day is recommended. Additional activity creates additional health benefits.
- For people of 18 years and older 150 minutes of moderate or 75 minutes of vigorous physical activity a week is the bare minimum. More desirable is weekly physical activity that goes on for twice as long, so a minimum of 300 and 150 minutes respectively. Striking a balance between moderate and vigorous physical activity is important as well.

In 2017, 25% of the Danish adults were not active enough to meet the minimum required physical activity set out by the WHO. Research showed that only 7% of 15-year-old girls and 16% of 15-year-old boys employed the recommended minimum amount of physical activity. This positions Denmark amongst countries with the lowest teenage activity across the EU (OECD/European Observatory on Health Systems and Policies 2019, p. 8).

In urban areas there are several environmental factors that can have a discouraging effect on people's willingness to be physically active outside their homes. The most predominant ones are high density traffic, bad air quality and general pollution, fear of violence and crime, lack of sidewalks, lack of parks or other recreational areas. Even though research shows there is some risk in using active transportation, the WHO states that (WHO 2018):

"At all ages, the benefits of being physically active outweigh potential harm, for example through accidents. Some physical activity is better than doing none."

Mueller et al. systematic review of current research investigating health impact assessments (HIA) of active transportation found, that the estimated health risks emerging by traffic incidents are small compared to its beneficial health effects gained by more physical activity amongst the population (Mueller, et al. 2015, p. 110). Utilising active mobility can therefore be an easy way to live up to WHO's recommendations and will have significant benefits on people's health (WHO 2018).

5.3.6 Public Transport in Denmark

Most statistics on public transport are comprised of numbers on transport by bus and train, therefore this part of the report is focussed on those two modes of transport.

The public transport system in Denmark is mostly used for longer distance travel. A staggering 98% of the trips made by public transport is longer than 4 kilometres (Christiansen and Baescu 2019, p. 9). The purpose of these trips is visible in Figure 11.

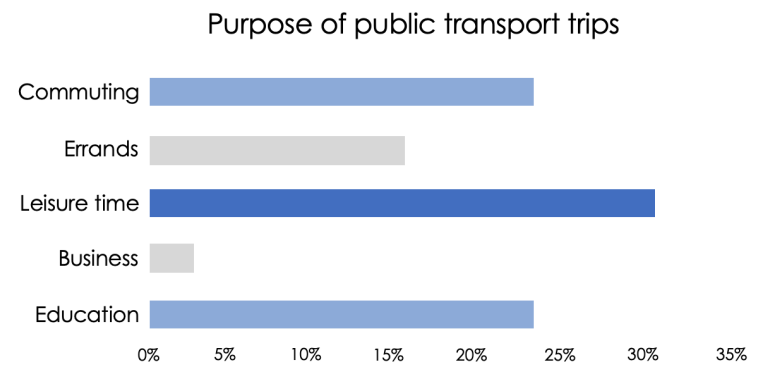

Figure 11: Purpose of trips by public transport by Danes (Christiansen and Baescu, TU årsrapport for Danmark 2018 2019, p. 14)

For these trips a Dane uses the bus for 1 kilometre a day and the train for 2,7 kilometres a day on average. They are in these modes of transport for 3 and 2 and a half minutes a day respectively (Christiansen and Baescu 2019, p. 6). The total amount of kilometres that public transport is used by people has been rising during the last three decades. This development is visible in Figure 12.

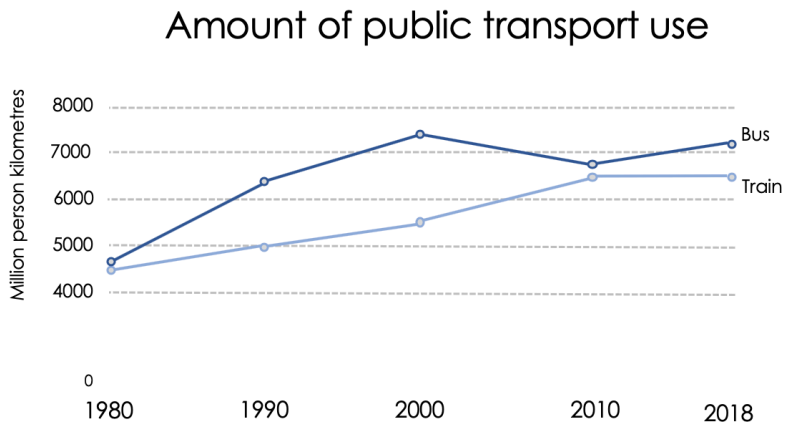

Figure 12: Amount of public transport use in Denmark (Statistics Denmark 2019)

5.3.7 Car-sharing in Denmark

Car-sharing is becoming a more and more popular alternative to owning a car, because it offers more flexibility and comfort than not owning a car, but without the commitments of maintenance and other costs associated with owning a car (Haustein and Nielsen 2015, p. 3). Because more people can utilize one car, a car-sharing vehicle has the potential to replace approximately 5 conventional cars (Haustein and Nielsen 2015, p. 10).

In Denmark there are five big car sharing services: GoMore, Car2Go, Green Mobility, Drive Now and Lets Go. There is a difference between them, because they either have their own fleet of cars and rent those out to people or they connect people to other private persons that rent out their own car (Dejlige Days 2018). The membership of these services was only 0.08% of the Danish population in 2006 and rose to 0.13% in 2014 (Haustein and Nielsen 2015, p. 5). After 2014 there are no encompassing numbers on the membership of car sharing services, but it is expected that the rise in membership accelerated throughout the years. This expected increase is based on car sharing making a name for itself and the trend that people make more sustainable choices in general. The total number of Danish car-sharing memberships between 2006 and 2014 is visible in Figure 13.

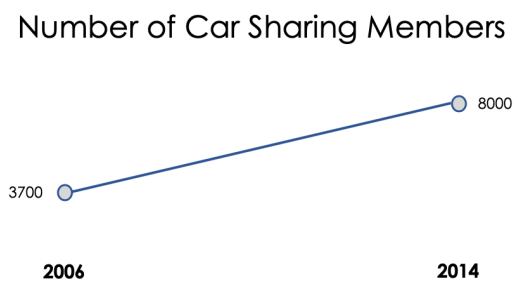

Figure 13: Number of car-sharing members in Denmark (Haustein and Nielsen 2015, p. 5)

These car-sharing members are the highly educated people within the Danish community. They have the means to own a car but choose not to. Usually they live either close to public transport or to their place of work. The typical profile of a car-sharer is someone with an average income of at least 300.000 DKK annually and a medium or higher secondary education. By adding this filter to the Danish adult population, 10% remains as possible user of car-sharing services. Within this group of possible users, already 90% of the households owns a private car. The potential within this group will rise in the coming years, because an increase of population within this exact group of people is expected (Haustein and Nielsen 2015, p. 5 - 7, 13).

5.3.8 Summary of Chapter 5.3

This subchapter summarizes the most important information of entire chapter 4.3.

Most trips in Denmark are made for leisure purposes (34%), running errands (29%) and commuting (23%). Together these three purposes account for 86% of all trips made. On average a Dane spends 56 minutes per day travelling between destinations and covers 38 kilometres while doing so.

The car represents 30 minutes of this daily travel time and it is used for 59% of all trips. This places Denmark above the European average of car use. The car is mostly used for leisure purposes and running errands. The total number of cars is still on the rise, but the ownership rate per household lies below the European average. Even though each household has relatively few cars, the occupancy rate of the vehicles on the road is one of the lowest in Europe. This low occupancy rate provides opportunities for car sharing during commutes.

Active mobility represents 35% of the total trips made in Denmark. This is a little over twice as high as the European average. It mostly used for leisure time and running errands. On average, biking accounts for 15% of these trips and walking for the remaining 20%. Fluctuations in these numbers occur throughout the year, because users of active mobility are exposed to al the elements. There is a huge dip in use in the winter months because of this. Cyclists are predominantly young people and use declines with age. E-bikes are changing this statistic, because they do not require the same level of physical fitness as a regular bike.

The high modal share of active mobility has a big advantage for public health, because inactivity increases the risk of getting diabetes, cancer, depression, hypertension, cardiovascular diseases, chronic lung diseases, impaired mental health and strokes as well. Inactivity is directly responsible for 2% of the annual deaths in Denmark and 25% of Danish adults do not meet the recommended weekly physical activity of the WHO. Among fifteen-year olds only 12% meets the recommended weekly activity. Increasing the use of active mobility can therefore be a good way to increase public health.

Public transport use is on the rise in Denmark and is mostly used leisure purposes, commuting and traveling to and from educational facilities. It is used for relatively long trips as 98% of the trips with public transport is longer than 4 kilometres. Especially the train is used for long distance travel.

Car sharing is relatively new and still gaining a wider user base. The typical user is highly educated, has an income of at least 300.000 DKK per year and lives close to either public transport or their place of work. Currently 10% of the Danish adult population fits this profile and this group is expected to grow. Therefore, potential for car sharing initiatives is growing as well.

5.4 Conclusion

Chapter 5 started with the goal to formulate an answer to sub-question 1. This question reads as follows:

"Why do people use the car, how can a behavioural shift be induced, and which transport options are commonly available in Denmark?"

This sub-chapter formulates a reply to this sub-question, but it is a multi-legged question that cannot be answered in a single sentence. It starts with why people use the car. A combination of the rational motives and the psychological factors for car use creates the following list of drivers for car usage:

- Modern society has been built around the car
- Absence of other infrastructure at place of residence or destination.
- Trips are not always simple A to B movements, but have stops at multiple locations along the way, and require a transport mode that is timely, flexible, reliable and available.
- Planning a trip ahead is undesirable.
- Having to leave at a specific time is undesirable.
- Freedom and flexibility of travel.
- Personalisation of the car, through both looks and inner soundscape.
- Having meaningful social interaction with co-workers, relatives or friends.
- Providing a time out from social interaction.
- De-stressing and recharging between activities.
- Comfort during travel.
- Showing status.
- Ingrained societal structures.

Secondly: how to induce a behavioural shift. In order to change the behaviour of people it is necessary to understand that travel habits are more likely to change if the overall agenda of behavioural change is embedded in a systemic change. This can be induced by:

- Utilizing strategies which address change in a gradual way.
- Addressing more stakeholders than solely citizens, since more stakeholders hold the power to change institutions. Signals send out to stakeholders need to be internally consistent and comprehensible.
- Forming desired habits at a young age, because habits can be re-called and re-activated.
- Addressing all facets of car dependency by using a wider range of targets.
- Avoiding a forced change in the socio technical regime through a top-down approach. Authorities, such as municipalities, have a more facilitating role in the transition into a new regime.
- Drawing on experience from practical examples. In the development process participatory methods are useful for creating novel and creative initiatives.

Lastly: the transport options that are available in Denmark. On average a Dane spends 56 minutes per day travelling between destinations and covers 38 kilometres while doing so. The car is the most used transport option (59%), but active mobility use is very high (35%) compared to the rest of Europe (16%). Public transport only accounts for 7% of the total trips and is mostly used for long distances. Car-sharing is relatively new but shows promise and is still growing. This information will be used to scope planning possibilities within Denmark.

6. Liveable Urban Space

The focus of this chapter lies with answering sub-question 2, which reads as follows:

"What are the main design considerations for liveable urban space and which best practices for transitioning into car free cities are there?"

Within this chapter the international efforts in regard to liveability are discussed, qualitative factors for creating liveable urban space are explored and best practices from the field are identified.

6.1 International Liveability Efforts

In order to look at efforts to improve liveability in a more local context it is useful to understand the overall paradigm that shapes urban liveability efforts. In the framework of this thesis the Sustainable Development Goals (SDGs) and New Urban Agenda (NUA) have been briefly touched upon. These are international frameworks that constitute the overall paradigm regarding urban liveability and therefore are the main focus of this sub-chapter.

6.1.1 Sustainable Development Goals

In the framework it was established that the SDGs were implemented in 2015 and are the successor of the Millennium Development Goals (MDGs) from the year 2000. Just like the MDGs before them, the SDGs focus on creating a more sustainable world within social-, economic- and climate fields, thereby tackling world poverty, hunger, climate change and equality (United Nations 2015, p. 3) (Way 2015, p. 4). Unlike the MDGs, the SDGs have a standalone goal for urban areas. The SDGs are comprised of 17 goals, that have a total of 169 targets that can be used to measure if the goals have been reached. The goals are set to stimulate action from 2015-2030 within 5 areas of importance for the human race (United Nations 2015, p. 3 - 4):

1. People
   Actions taken must include measures to end poverty and hunger and ensure that human beings are living in a healthy environment, so they are able to fulfil their own potential with dignity and equal rights for all.
2. Planet
   Actions taken must protect the planet through promoting sustainable consumption and production, managing natural resources and tackling climate change on behalf of the present- and future generation.
3. Prosperity
   Actions taken must ensure a prosperous and fulfilling life with economic-, social-, and technological progress occurring in harmony with nature.
4. Peace
   Actions taken must foster just, peaceful and inclusive societies free from violence and fear.
5. Partnership
   The interlinkages between the goals presented in the SDGs makes local, national and international cooperation crucial in creating a better future for generations to come. Therefore, a revitalised global partnership for sustainable development is of utmost importance for making sustainability the standard when planning for the future (Ibid.).

The 17 Sustainable Development Goals are presented as one entity, but goals can be selected individually and therefore action can be taken within very specific areas. In general, the goals aim to create a sustainable world for people. Because of this, a significant number of goals can be traced back to the term 'liveability'. This leads to parallels between urban liveability and certain development goals that deal with the same issues.

The sustainability concept is divided in three types of sustainability; economic, social and environmental. When combined, they resolve in something fully sustainable. The three different sustainability elements are intertwined in the 6 categories that comprise liveability used in this project (see chapter 2.1) thus, when looking into cities and liveability it is relevant to look into the different SDGs that are related to the matter at hand. Goal 11 of the SDGs is the goal matches the best with the research, as it promotes sustainability in cities and communities. This does not mean the other goals are irrelevant, because the SDGs are

highly intertwined with one another. In order to create a clearer vision on how the goals relate to this research, they have been categorized. The categorization of the SDGs can be seen in Image 9 below and consists of three overall categories; 'Basic Human Needs', 'Environment' and 'Sustainable Economy'.

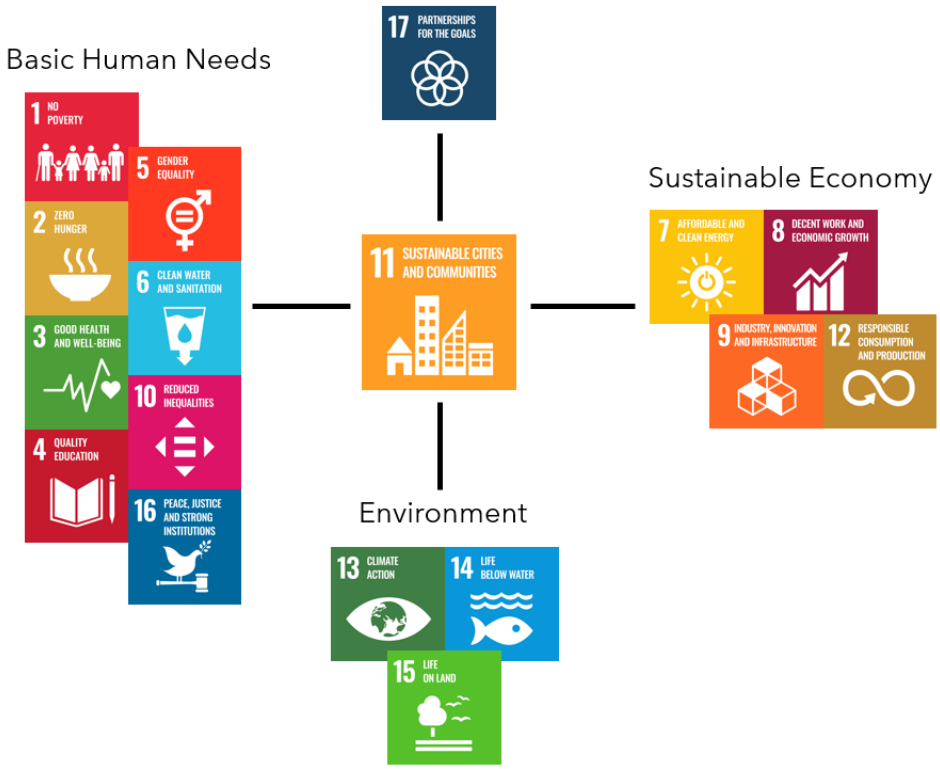

Image 9: Categorizing SDGs for this thesis

The basic human needs provide the base for good well-being and therefore to obtain a basic level of liveability. The group consist of 8 goals. The sustainable economy category is made up of 4 goals and aimed at sustaining or developing the economy in a more sustainable way and create jobs that support fair wages and rights for the employees. The sustainable economy goals add a level of liveability to the basic human needs. The environment category is made up of three goals, which aim to create a more sustainable environmental future in which climate, water and life on land play a key role. This group provides the city with less heat, lower pollution and sustainable leisure activities that add a layer of liveability for people. A brief explanation of all these goals can be found in the Appendix (33) and only the most relevant ones are highlighted in this chapter.

Goal 11: Sustainable Cities and Communities

This goal is the most relevant SDG for this thesis, because it aims to:

> *"Make cities and human settlements inclusive, safe, resilient and sustainable"*
> (United Nations 2015, p. 24)

Since most people live in cities, it is the optimal place to plan for sustainability on an environmental, economic and social level. Liveability is closely connected with human wellbeing, and social liveability is the natural focus. However, economic status and

environmental factors also impact the wellbeing of people. If someone loses their job, they might not be able to support their family and move out of their home. Likewise, environmental factors also impact wellbeing. A city that is heavily polluted due to its traffic flow, the bad air quality increases the chances of getting a disease and even for an early death (World Health Organization 2017). Noise-related annoyances from traffic can furthermore increase the risk of stress and thereby influence wellbeing (Ouis 2001, p. 101). Goal 11 ties into this by focussing on the presence of services such as affordable housing and sustainable planning of future housing, efficient and sustainable transport systems, flood resilience, air quality issues, greenery, public spaces and strengthening the connection between urban and rural areas. This goal therefore covers a lot of elements of liveability in an urban environment, but it is not the only goal that affects urban liveability. Other goals that should be considered within projects that address urban liveability are described below.

Goal 3: Good Health and Well-being

Health, well-being and liveability are closely connected and therefore this goal is relevant for any research regarding liveability. This SDG aims to:

> *"Ensure healthy lives and promote well-being for all at all ages"*
> (United Nations 2015, p. 18 - 19)

SDG 3 focusses on the eradication of diseases, maternal and new-born mortality rate and health and safety in cities. It aims to decrease road traffic incidents as well as deaths by at least 50% before 2030. In order to reach a healthy, thriving society, challenges within health, including the knowledge to preventing these issues, must be dealt with. Only thereafter will citizens be able to live without fear for their safety (United Nations 2015, p. 18 - 19). Creating an urban area that is safe to navigate impacts SDG3.

Goal 9: Industry, Innovation and Infrastructure

Infrastructure is a key element in reclaiming space from the car, therefore this goal is relevant for this research. It aims to:

> *"Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation"*
> (United Nations 2015, p. 22 - 23)

SDG 9 focusses on the promotion of new small-scale industries, clean production and state of the art infrastructure to fuel the economy. The infrastructure is both visible, in the form of roads and railways, as well as hidden in the form of the electricity grid, internet and phone lines (United Nations 2015, p. 22 - 23). The creation of alteration of infrastructure that builds on resilience impacts SDG9.

Goal 10: Reduced Inequalities

Inequality leads to stress in the disadvantaged groups. Exclusion decreases liveability and therefore this goal is relevant for this research. It aims to:

> *"Reduce inequality within and among countries"*
> (United Nations 2015, p. 23 - 24)

SDG 10 addresses many different aspects of inequality. The main focusses are decreasing wage gaps, inclusion of all and equal opportunity for everyone. These equal opportunities and inclusion of all are important in the urban environment as well (United Nations 2015, p. 23 - 24). Public space that is inclusive and accessible to all impacts SDG 10.

Goal 13: Climate action

Climate change affects all regions of the planet and the urban environment is not exempt from this. More extreme weather conditions and greenhouse gas emissions decrease liveability and therefore this goal is relevant for this research. It aims to:

> *"Take urgent action to combat climate change and its actions"*
> (United Nations 2015, p. 25 - 26)

SDG 13 focusses on integrating climate change measures into national planning, policy and strategy as well as improving awareness through education (United Nations 2015, p. 25 - 26). Creating urban environments that promote more sustainable behaviour impact SDG13.

Goal 15: Life on Land

Life on land is everywhere and besides humans, plants and animals inhabit cities as well. Development in urban areas impacts this goal and therefore it is relevant for this research. It aims to:

> *"Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt reverse land degradation and halt biodiversity loss"*
> (United Nations 2015, p. 27)

SDG 15 focusses on increased biodiversity and more area for ecological systems. In cities this can vary from lining streets with trees to incorporating neighbouring ecosystems into the structure of the city (United Nations 2015, p. 27). Urban development that introduces more greenery into the urban environment impacts SDG 15.

Goal 17: Partnerships for the Goals

Partnerships in global context are the core of this goal. Global partnerships to generate more knowledge, best practices, ideas and financial support can the urban transition into sustainable cities faster and easier, therefore this goal is relevant for this research. It aims to:

> *"Strengthen the means of implementation and revitalize the global partnership for sustainable development"*
> (United Nations 2015, p. 28)

SDG 17 focusses on global partnerships regarding financial support, technology sharing, helping the ones that do not have the means, trade and systemic issues in governments (United Nations 2015, p. 28). In an urban setting this means that cities and/or countries work together and support each other in the efforts of getting more sustainable, the process could be sped up and the end goal achieved more easily since it becomes a joint effort both creational and financial. Cooperation can be a way of making the transition towards sustainability easier. This cooperation impacts SDG 17.

6.1.2 New Urban Agenda

The New Urban Agenda (NUA) was founded in 2016, at the United Nations Habitat III Summit on Housing and Sustainable Urban Development in Quito, Ecuador. The agenda sets up a new global standard for how to plan for sustainable urban development, thereby creating a framework on how cities should develop for the future (United Nations 2017, p. iv - v). The agenda sets up 175 commitments, that all frame more sustainable urban development. Because the agenda is of un-formal character, nations are not at risk of repercussive measures for not following the NUA even though their leaders have signed- and committed to it. However, it is believed that if the NUA were to be followed, a sustainable urban sphere would be ensured both economically, socially and ecologically. The NUA puts the focus of planning on people-centric design as it states signees commit to the following (United Nations 2017, p. 8):

"Adopt sustainable, people-centred, age- and gender-responsive and integrated approaches to urban and territorial development by implementing policies, strategies, capacity development and actions at all levels, based on fundamental drivers of change."

The NUA has a strong focus on intergovernmental cooperation, which is viewed as one of the most important factors to success. Because the NUA is presented as a "universal" solution for a sustainable urban future, the issues dealt with in the agenda may not equally relevant for every region in the world. The NUA was founded on the following principles that illustrate this discrepancy well (United Nations 2017, p. 7):

"Leave no one behind, by ending poverty in all its forms and dimensions, including the eradication of extreme poverty, by ensuring equal rights and opportunities, socioeconomic and cultural diversity, and integration in the urban space, by enhancing liveability, education, food security and nutrition, health and well-being, including by ending the epidemics of AIDS, tuberculosis and malaria, by promoting safety and eliminating discrimination and all forms of violence, by ensuring public participation providing safe and equal access for all, and by providing equal access for all to physical and social infrastructure and basic services, as well as adequate and affordable housing."

A significant number of these challenges concern the social aspect of sustainable urban environments and are more obviously lacking in developing countries. Most western countries face a multitude of these problems to a lesser extent and can focus more on attaining quality of life criteria instead of the basic needs. The NUA repeatedly addresses the need for governmental agencies and other stakeholders to cooperate in creating sustainable solutions, because no single actor or level of governance can fully address sustainability by itself (United Nations 2017, p. 8, 15, 22 - 25, 32, 36 - 37). In order to achieve this cooperation, the NUA contains the following commitment (United Nations 2017, p. 8):

"Readdress the way we plan, finance, develop, govern and manage cities and human settlements, recognizing sustainable urban and territorial development as essential to the achievement of sustainable development and prosperity for all."

Countries can share their knowledge, efforts and manpower to accelerate the development of sustainable urban environments around the world. Multiple stakeholders working on the same challenges increases the chance of solving those problems (Valencia, et al. 2019, p. 11). This means that international collaboration has a lot of untapped potential.

The NUA is created to be a tool for future planning and the way it is used and interpreted is very important for the day to day work of planners and officials. Research has identified five considerations that should be addressed when implementing the New Urban Agenda. They are listed below (Valencia, et al. 2019, p. 7 - 19).

1. Delimiting the urban boundary

   Create a clear scope by defining the urban area, this way all relevant practices, policies and actors can be identified and included.

2. Integrating governance

   Different sectors within governments usually operate as isolated departments and interdepartmental cooperation needs to be established in order to create inclusive development.

3. Including actors

   It is important to include a multitude of actors in order to create solutions that as many people as possible support. It is important to realize that within the same population group or sector there can be many different opinions. Only including one actor per population group or sector is not sufficient because of this.

4. Considering trade-offs and synergies

   Before solutions are implemented trade-offs and synergies need to be considered in order to assess how the implementation affects other sectors and aspects of daily life.

5. Making use of indicators

   In order to assess how well an initiative works it is necessary to make use of predetermined indicators. Local monitoring initiatives are suitable, but if these are absent the SDGs can take their place.

6.1.3 Summary of Chapter 6.1

Within the MDGs there was no standalone goal that addresses the urban environment. The 2030 agenda with the associated SDGs has introduced this urbanity within its scope by including goal *11: "Sustainable cities and communities"*. Combine this with the creation of the NUA and it becomes clear that the role cities play in creating a sustainable future has been recognized. This means that there is increased funding and policy attention for the urban areas (Valencia, et al. 2019, p. 5).

As SDG 11 is fully focussed on the urban environment, it has the most connection to this research and is seen as the most affected goal by urban liveability initiatives that reclaim space from the car. However, there are other goals that are of importance in regard to this topic and they are listed below.

- SDG 3: Good Health and Well-being
- SDG 9: Industry, Innovation and Infrastructure
- SDG 10: Reduced Inequalities
- SDG 13: Climate action
- SDG 15: Life on Land
- SDG 17: Partnerships for the Goals

For planners that reclaim space from the car and create a more liveable environment this means that they should not focus solely on SDG 11, but also consider how they can tie into these six SDGs.

The NUA highlights the importance of international cooperation to make a swift and qualitative shift towards sustainable urban environments. There is a key role within its strategy for inclusive and integrated people-centric planning for all ages and genders. People that seek to implement the NUA need to include the following actions within their plans:

1. Delimiting the urban space to define project boundaries
2. Integrating different levels and sectors of governance
3. Including a multitude of actors
4. Considering trade-offs and synergies with other sectors and daily life
5. Making use of indicators for measurement

6.2 Local liveability

Now the overarching global paradigm on liveability has been established, a framework for the exploration of local liveability is in place. This sub-chapter is focussed on that exploration. It will start off with a brief history of urban life as we know it, followed by an explanation on what constitutes a people-centric urban area, the know-how of creating liveable urban space, liveability indexes and the liveable city utopia.

6.2.1 A Brief History on Urban Life

Urban life as we know it today is significantly different than it was in the 19th century, where life on the streets revolved around essential work-day errands. The activities that forego in the city can be described as necessary activities and optional activities, where the optional ones are recreational and non-essential to everyday life. Since the early 1900's the amount of necessary activities declined until the 1960's, when optional activities began to increase with the emergence of passive activities. These are activities such as standing, walking and sitting. With the introduction of the car on the Danish streets in the 1950's, and the increase in income of the general population, the number of cars increased rapidly throughout time and the streets in Danish cities quickly became congested. This led to a change in use of the inner city from necessary activities to activities revolving around shopping. The city was being used in a new way. The streets were now dominated by cars and in the 1960's Copenhagen introduced the world's first pedestrianised street for shopping. One of the factors for introducing the pedestrianised street, was the competition from the Americanised mall-like facilities outside the city centre, where you could park the car and be free of the disturbance of traffic when shopping. A third change in use emerged during the 1990's where the city is now not only used for shopping, but also increasingly used for recreational activities such as big events, like festivals, sport events or parades and for small-scale individual recreation such as running or walking; the active activities. When use and activities in the city changes, the design and the planning of a city changes as well. City space then becomes the facilitator for public life. The use of the city and the design hereof is essential to creating a city for people (Gehl, Gemsøe, et al. 2006, p. 8-17).

6.2.2 People-Centric Urban Space

Jan Gehl, a pioneer within citizen centred urban life development, distinguishes between three overall types of city spaces that serve three vital functions of a city: Meeting place, marketplace and connection space. These spaces facilitate social life, economical activities and transport opportunities in an urban area. Places must be equipped to handle a multitude of activities, because different activities occur according to the intentions of the people who find themselves in the city (Ibid.). Three general types of activities can be said to take place according to Gehl: Necessary activities, optional activities and social activities (Gehl 2011, p. 9).

Necessary activities include activities in for example transport- or marketplaces, where transport to school or work and shopping take place. These types of activities call for efficient places, where time is an important factor to the success of the space. If the path is blocked with trees and people therefore have to change directions multiple times, the space is not suited for convenient-, fast- and logical transport hubs. Therefore, the matching of intended use and the design of places are essential in order to create usable areas in an urban core. This is illustrated in Image 10: The relation between the quality of urban space and the amount of activity in it Image 10, where the correlation between design and use is sketched (Gehl 2011, p. 11).

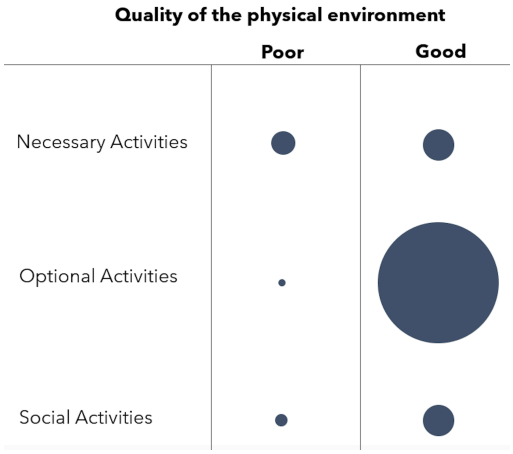

Image 10: The relation between the quality of urban space and the amount of activity in it (Gehl 2011, p. 11)

Image 10 shows that activities thrive when the quality of the built environment is adequate. However, it is not only the built environment that enables city life. Governments and City Officials play a significant role in enabling life in the streets as well by framing policies towards urban life. Opening times of shops are in many places controlled by legislation, both business hours and whether or not they can open on weekends. If these restrictive policies were to be changed to allow weekend service or extended business hours, urban life will be impacted. It will make citizens populate the urban environment in wider timespans throughout the day. Therefore, a change in policy can lead to an increased use of the urban core and thereby an increased use of the shops, facilities and services that the city has to offer (Gehl, Gemsøe, et al. 2006, p. 8-17)

Urban life cannot solely be described by three types of places and their uses but revolves around many functions that together make up a daily life for the citizens. Gehl has identified 10 types of elements that need to be accounted for when designing urban areas in order to create a city for people (Gehl, Gemsøe, et al. 2006, p. 14-17).

- Transport
- Work
- Sustainability
- Health
- Recreation
- Social interaction
- Information and inspiration
- Democracy and diversity
- Friendliness and a feeling of security
- Room for the unexpected

Most of these elements are ingrained in the optional and social activities of people's lives and can be embedded in both meeting- market and transport places. Therefore these 10 elements are key elements when designing a city for people (Gehl, Gemsøe, et al. 2006, p. 14-17). The elements furthermore correlate with the liveability elements identified in chapter 2.1. If an urban plan is created utilizing the 10 key elements for people centric urban design, the plan will encompass the key reasons of use, their related spaces and ensure liveability.

Utilizing planning frameworks could therefore lead to major improvements in the quality of urban life and an overall improvement in liveability. This is due to the fact that the urban life key elements identified by Gehl and the key liveability elements identified in chapter 2.1 (framework) are similar in focus.

6.2.3 Creating Liveable Urban Space

One cannot just assume that liveability is automatically created whenever new urban projects are carried out. Including liveability aspects would be a beneficial addition to every initiative or plan dealing with urban space. Utilizing citizen participation within liveability aspects makes the citizens able to be a part of the development in their neighbourhood and therefore take part in shaping the city in a way they need or desire it to be. However, as previously described in chapter 2.1, liveability can be a difficult term to define and use because of the multitude of understandings about what comprises it. The different understandings can stem from individual preferences and culture to the context of the local area. It can be challenging for planners to create a liveability framework that includes both basic and more developed forms of liveability in order to be suitable for general use. Examples of basic forms of liveability are traffic security and a feeling of safety and examples of more developed liveability could be opportunities for recreational activities and aesthetics (Gehl, Gemsøe, et al. 2006, p. 106-107).

In 2006 Jan Gehl et al. created 12 quality criteria for liveable spaces, which he presented in the book "New City Life". The criteria function as checkpoints in order to create a liveable urban space on a more local human scale. The criteria are divided into three overall groups: Protection, comfort and enjoyment, where protection and enjoyment boast 3 criteria each and comfort 6 (Gehl, Gemsøe, et al. 2006, p. 107), (Gemsøe 2006). The key 12 quality criteria for liveable urban space are visible in Image 11.

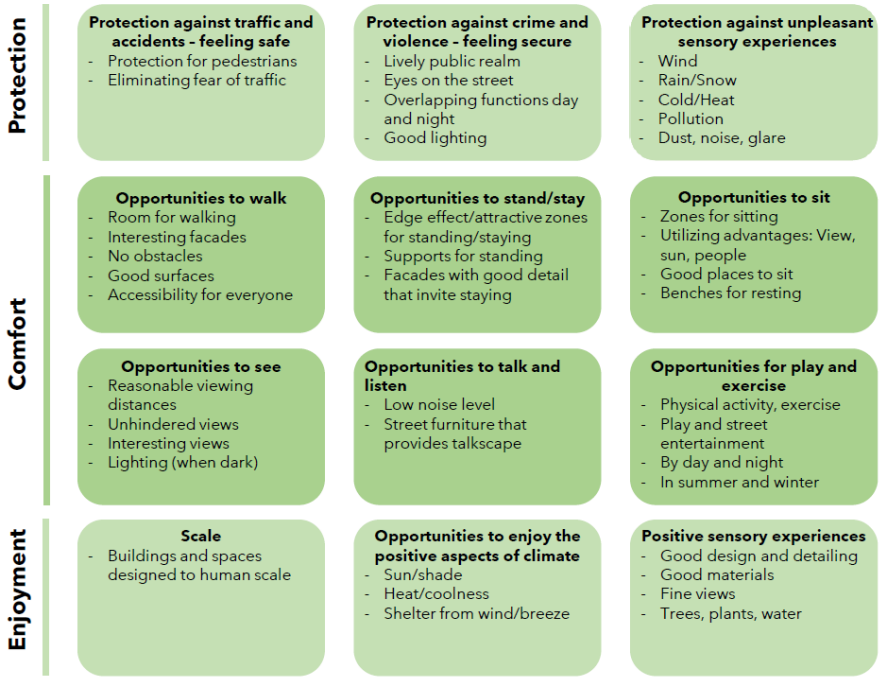

Image 11: The 12 quality criteria for liveable urban space (based on (Gehl, Gemsøe, et al. 2006, p. 107))

Protection

These criteria focus on the improvement of the experienced and believed environment in cities in regard to infrastructure and traffic, crime and sensory experience. Unpleasant experiences should be avoided, and a feeling of safety created. This is necessary in order to prevent discomfort and displeasure in urban spaces. Good city spaces should create opportunities for pedestrians and cyclists to experience the city in a safe way, avoid dark areas, mix diverse functions to create use by day and by night and protect people from elements that negatively impact the senses. The most important aspects of protection are (Gehl, Gemsøe, et al. 2006, p. 107) (Gemsøe 2006):

1. Protection against traffic and accidents, therefore creating a feeling of safety on the road.
2. Protection against crime and violence, therefore creating a feeling of security.
3. Protection against unpleasant sensory experiences.

Comfort

These criteria revolve around the creation of places where people are comfortable. Comfort is created by making people want to stay. This is done by creating possibilities for:

4. Walking
5. Standing/staying
6. Sitting
7. Seeing
8. Hearing/talking
9. Recreational- and cultural activities

A city needs to plan for spaces that encompass these elements in order to make the space comfortable for citizens. Furthermore, spaces should promote both active and passive types of experiences in order to enable a multitude of use of the space and make the space more inclusive for people with disabilities (Gehl, Gemsøe, et al. 2006, p. 107) (Gemsøe 2006).

Enjoyment

These criteria deal with the design and scale of an area, which includes materials and the physical setting. A cityscape is not enjoyable if it is vast and bare, because there is nothing to look at, if the materials used are not aesthetically pleasant or if there is no urban greenery. Furthermore, it is important to design the space in a way that makes it possible to enjoy the positive aspects of the climate, such as sun, shade and ventilation without it being either too much or too little. The most important aspects that influence enjoyment are (Gehl, Gemsøe, et al. 2006, p. 107) (Gemsøe 2006):

10. Scale of the space
11. Possibilities to enjoy the positive aspects of local climate
12. Aesthetic quality and quality of materials used

Jan Gehl's 12 quality criteria can be used as a tool to create new or reshape existing areas into liveable urban spaces. The tool serves as a measure to which a space is to be held and makes clear what needs to be done in order to improve the liveability. It encompasses both very basic liveability elements such as protection and safety, but also more elaborate and expensive elements such as aesthetics, design and possibility for activities. Due to this extend of the tool, the framework can be used by every planner in any urban context.

The work of reshaping a space becomes easier, because planners can pick up where the space lacks quality. By including previously left criteria, the space immediately becomes more liveable. However, it is cheaper and easier to use the framework as early as possible in the planning process in order to create a complete liveable space from the start.

6.2.4 Liveability Indexes

In recent years liveability indexes have been created to rank cities all over the world on the basis of their liveability. The indexes typically identify or rank the "Most liveable city" in the world, continent or region, thereby assessing which locations worldwide provide the best and/or worst living conditions (Rozek, Giles-Corti and Gunn 2018). These lists are often taken up by the media and used as promotion material by local city governments. However, the usability of these lists for local people is debatable. The lists are often tailored to citizens moving abroad or employers looking for the amount of hardship allowance. Therefore the liveability in the indexes might not correlate with the experienced liveability of citizens in the concerned cities (Rozek, Giles-Corti and Gunn 2018), (ECA International 2020), (Mercer 2019). This means that parameters of interest for companies and expats are prioritized while local interests are not. The most well-known indexes are (The Economist Intelligence Unit 2019) (ECA International 2020) (Mercer 2019):

- The Economist Intelligence Unit's "Global Liveability Index"
- ECA International's "The Global Liveability Report"
- Mercer's "Quality of Living Ranking"

There are also official governmental ranking systems such as the "Liveability Standards in Cities" of India's Ministry of Urban Development (Government of India n.d.) and private companies such as Ramboll's liveability aspects (Norn 2018) (Norn 2017).

The world's leading liveability index is the Global Liveability Index that measures liveability on 30 indicators distributed across five categories of liveability: Stability (safety), health care, infrastructure, culture and environment and education (The Economist Intelligence Unit 2019). In this index, local factors such as public education, housing affordability, walkability, lack of public transport and traffic congestion are not considered in the calculations, reducing the usability of the index for true local liveability (Rozek, Giles-Corti and Gunn 2018). A list of what the different liveability indexes are comprised of can be seen in Table 1 below, where the criteria have been categorized per topic.

EIU	ECA	Mercer
Stability	Political tensions	Political and social environment
		Economic environment
	Personal safety	Socio-cultural environment
		Consumer goods
Healthcare	Availability of health services	Medical and health considerations
Infrastructure	Infrastructure	Public services and transportation
Culture and environment	Climate	Recreation
	Air quality	
	Isolation	Natural environments
	Housing and utilities Access to a social network and leisure activities	Housing
Education		Schools and education

Table 1: Categorized criteria used by liveability indexes (The Economist Intelligence Unit 2019) (ECA International 2020) (Mercer 2019)

In their smart city program, the Indian Government has developed a framework for measuring- and planning for liveability in cities. The framework uses many of the same elements and indicators as used in the liveability indexes, but also utilizes elements such as governance, employment, inclusiveness, public and open spaces, mixed land use, mobility and water-, waste- and pollution management. These are all factors that affect the daily life of citizens and city life in general. This framework therefore has a stronger potential to rank cities from the citizens point of view instead of foreigners.

A critique on the usual liveability indexes or rankings is that they do not distinguish between neighbourhoods within a city. Citizens that live in different parts of the ranked city can have a totally different experience of liveability within the city from one another, let alone what is presented in the indexes (O'Sullivan 2020). Khomenko et al. investigated if a liveable city is also a healthy city and found that there are significant differences in the mortality of areas within Vienna, even though Vienna as a whole was ranked 'the most liveable city' in both 2018 and 2019 on the Global Liveability Index (Khomenko, et al. 2020). This illustrates that a liveability score or rank, which does not differentiate between neighbourhoods in a city is not a viable option for correctly presenting a city's liveability. Liveability is heavily influenced by the local physical environment and is therefore difficult to capture on a city scale. It makes sense to zoom in on specific areas or neighbourhoods in the city to measure liveability in a meaningful way. When done locally, the analysis can be of more use for local governments than one score for an entire city. The 12-quality criteria framework developed by Gehl is a good tool to use in this regard, since it takes very local city spaces and identifies liveability from the perspective of the user.

For planners this means that they need to take liveability into account in a more local context. Parameters differ throughout the city and should be reassessed with every project. Local scale planning is crucial when planning liveable neighbourhoods where the focus lies on the human scale.

6.2.5 Liveable City Utopia

The Masdar city area, a suburb to Abu Dhabi, is actively working to become car-free. In 2008 the foundation for the new Masdar area was created in order to plan and develop a truly sustainable and liveable city on human scale, where pedestrians are prioritised. The area of 640 hectares is to be developed as green-field development, and serve as inspiration for cities all over the world on how to achieve success while accommodating rapid urbanisation, liveability and reducing carbon emissions at the same time (Masdar City n.d.) (Alameri 2011).

Image 12: Rendering of Masdar city upon completion (Forgemind Archimedia 2016)

In order to accommodate the car-free agenda, the planners found inspiration in, among others, J. H. Crawford's work on car-free cities. Therefore, they facilitate other modes of transport within their territory. The proximity to the airport- and the downtown area of Abu Dhabi is a key feature in this new city area. However, it also provides challenges. When people want to go outside Masdar, they cannot walk or bike because outside of this specific area there is no infrastructure for it. As a remedy Masdar seeks to integrate multiple modes of mass transit by utilizing LRT (Light Rail Transit), Metro, high speed rail lines and new bus connections.

Mobility measures not commonly known within transportation systems are implemented as well. Examples are the novel driverless PRT (Personal Rapid Transit) system, that connects the main parking facilities on the edge of the neighbourhood with central Masdar, and the GRT (Group Ride Transit) that will circle the city until the LRT is completed. The following mobility concepts are planned in Masdar (Alameri 2011):

- An LRT with 4 stops throughout Masdar that connects Masdar with downtown Abu Dhabi and the Abu Dhabi Airport.
- Metro and busses to service Masdar and the surrounding areas.
- The construction of a new, central, mobility hub which facilitates transfers between high speed trains, metro, LRT and busses servicing the whole Abu Dhabi area.
- E-taxis travel in the car-free zone for citizens that are unable or do not desire to bike or walk.
- Public space and recreational facilities have been planned with 6,6 square meters per citizen, thereby exceeding the average of public space per citizen for The Arab Emirates and many suburbs in Europe.
- Bike and pedestrian infrastructure are prioritised.
- Roads are planned for mixed use, with priority for pedestrians and cyclists.
- Masdar seeks to reduce the number of cars and their impact on the rest of Abu Dhabi by introducing parking fees for the use of car-park facilities in Masdar. This is done in order to get people to utilize the improved public transportation system instead of private cars.
- The planners of Masdar know that citizens are forced to use cars for some trips. Therefore car-sharing and car-pooling initiatives have been set up, thus abolishing the necessity to own a car.

Urban planning with liveability as an integral part of the design process is important. However, Masdar is a unique place. Not all cities have an empty lot of 640 hectares to work with. Masdar can thus be seen as a planner's utopia. Greenfield development is by far the easiest way to plan for liveability, since all liveability criteria can be implemented from the beginning. When a planner is enabled to plan all aspects of an area a more holistic approach can then be taken, utilizing both current and expected future technologies and discourses. However, this is rarely seen, and most cities are expected to re-shape their current neighbourhoods in order to heighten the liveability for its citizens. In reality a city cannot yet function solely on non-car traffic and transportation of goods, because urban areas in close proximity usually still rely on cars. Therefore, a completely car-free city is a utopian vision in the current timeframe.

6.2.6 Summary of Chapter 6.2

Within this chapter, insight has been provided in the way liveability can be measured and established that local measurements are needed in order to provide meaningful results that planners can use. There is a strong correlation between the quality and the use of a space. Liveability indexes do not consider different localities within a city and are therefore not useable. The 12 quality criteria of urban space from Jan Gehl are recommended as a way to operationalize urban liveability from a planning perspective. They are visible in Image 13 below.

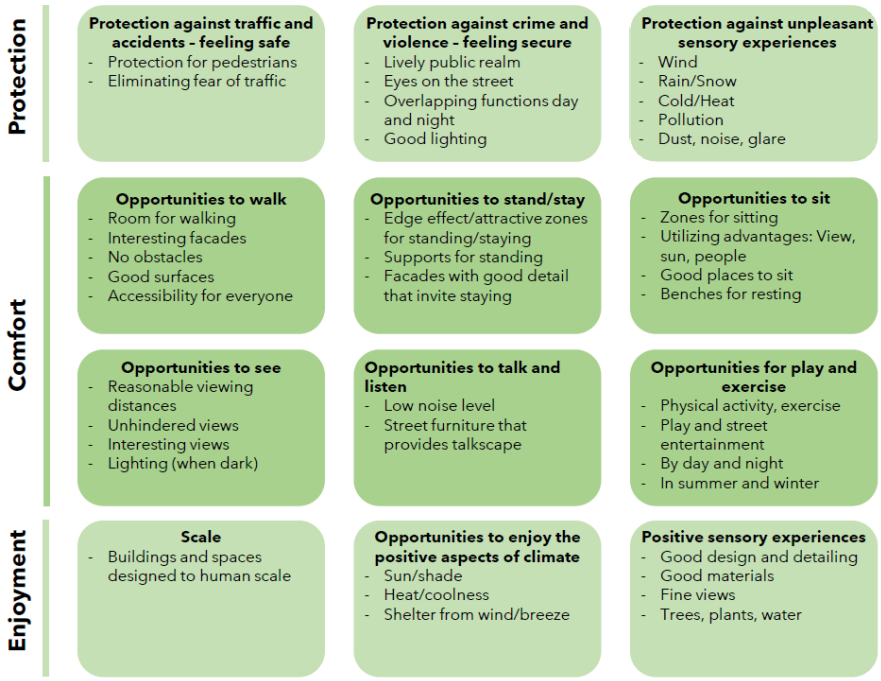

Image 13: The 12 quality criteria for liveable urban space (based on (Gehl, Gemsøe, et al. 2006, p. 107))

Furthermore, it has been established that it is utopian thinking to expect cities to become completely car free in the near future, because the connections to the rest of the world still rely heavily on car usage. For planners this means that the change should be gradual, and focus should lie with diminishing car use in general and limiting the space cars have within an urban environment in order to eventually transition into a car-free city.

6.3 Design Considerations

When designing a fully functioning city-, neighbourhood- or street without cars, designers and planners have to take various design criteria into account. A car free area can only succeed if all citizens are able to cover their daily needs without a car and all common services are present. Since the actual design of a car free area depends heavily on the area size, local context (including pre-existing infrastructure) and citizen's needs. The following sections therefore can only provide a general overview of different design considerations for projects that reclaim space from the car. The overall design considerations will be discussed first, followed by design considerations for pedestrians, cyclists, public transport, cars and goods.

For those who are interested in building a completely car free city from scratch might be interested in the "Carfree Design Manual" written by J.H. Crawford (Crawford, Carfree Design Manual 2009). His book is focussed at creating a car free city from scratch. However, some elements can be used in redeveloping car free space and will therefore be mentioned in the following overall design recommendations for creating inviting car free areas and supporting active modes of transportation.

6.3.1 Overall Design Considerations

According to Crawford a car-free city should be a city which provides a high level of quality of life. To achieve this, the following overall design goals need to be met:

> "Opportunities for informal social contact, safe and early independence for children, continued self-reliance of the elderly, ease in meeting life's daily needs, mixed uses in every neighbourhood, routine destinations located within the district, ample pedestrian traffic to assure safe lively streets, low noise levels, small gardens behind most buildings, accessible natural areas."
> (Crawford, Carfree Design Manual 2009, p. 132)

Based on this list it becomes apparent that Crawford's design criteria for quality of life go hand in hand with aspects of liveability. All these goals can be achieved through taking different design elements into consideration when implementing infrastructure in car free or car reduced areas.

The streets

Car free cities and areas need a well thought through network of streets, which can facilitate people's everyday life, transport of people and goods and maintain adequate reachability for occasional heavy transport and emergency vehicles. Streets are the "*stage of public life*" (Crawford, Carfree Design Manual 2009, p. 263), which means that they facilitate stays, commuting, interactions with other people. Furthermore, they form standards of behaviour and showcase cultural facets as well (Crawford, Carfree Design Manual 2009, p. 263). This illustrates why accessibility for all citizens is so important and it can be achieved by avoiding physical barriers (Crawford, Carfree Design Manual 2009, p. 155).

In order to maintain efficient land use, streets should be as narrow as possible, but still be capable to adequately facilitate different functions and ensure accessibility for emergency vehicles (Crawford, Carfree Design Manual 2009, p. 261). This accessibility can be ensured by building wider lanes for bicycles, which are wide enough to accommodate emergency vehicles as well (Crawford, Carfree Design Manual 2009, p. 160). New possibilities, arrangements and alternatives like this have to be considered for the following types of heavy traffic: maintenance vehicles, moving trucks, construction equipment and trucks in

general (Crawford, Carfree Design Manual 2009, p. 176). Another aspect that should not be overlooked is the handling of waste. A district depot and local containers are advised (Crawford, Carfree Design Manual 2009, p. 182).

Urban safety
The feeling of safety in a city can be enhanced through two different initiatives. The first is building the living environment in a way that discourages criminal activities and the second is creating a social environment in which neighbours get to know each other and thereby become more likely to look out for each other. These two safety measures can be achieved in relatively dense areas with a mixed use of urban areas to maintain activities at any time of the day. Avoiding the use of ground floors for garages or storage and instead install many windows on the streets from which neighbours can overview the street life is key (Crawford, Carfree Design Manual 2009, p. 105 - 106, 284). Further and more specific measures on increased safety in mobility is written in the walking and biking paragraphs of this chapter.

6.3.2 Design Considerations for Pedestrians

In car free areas active mobility is prioritised and often transport on foot takes the lead role. Walking tends to be impacted by land use and responds to characteristics of the built environment. These characteristics can be changed by policies. They include network connectivity, mixed use of areas, the population density and the proximity to non-residential destinations (Muhs and Clifton 2016, p. 149, 158). These networks should link public spaces and other places of interest together and have dedicated pedestrians crossing on the way (Hunkin and Krell 2019, p. 3).

Route planning for pedestrians
Spatial planners have to keep in mind that most people prefer direct walking routes or shortcuts and walk through interesting and inviting human-scale environments. Therefore winding, uninterrupted and interesting pedestrians' paths should be built in order to trigger the senses (Gehl 2011, p. 137, 141). People tend to be more willing to travel longer distances on foot through an interesting environment, due to the shorter experienced length of the trip. On the other hand, boring or difficult routes will feel way longer than the actual travel distance (Gehl 2011, p. 137). Routes become more attractive for pedestrians if greenery and seating areas are added along the way (Hunkin and Krell 2019, p. 3).

Walking distance
In ordinary scenarios for healthy people, the average accepted walking distance to their desired destination is around 400-500 meters. Though the accepted walking distance can vary due to the described correlation between quality and the perceived length of the route (Gehl 2011, p. 137). Another best practice regarding walking distances is that 5-minute walks result in optimal use. However, if necessary the walking time can be extended to approximately 10 minutes, as long as the walk takes pedestrians through pleasant environments (Crawford, Carfree Design Manual 2009, p. 101).

Pedestrian streets capacity
Pedestrians need to walk freely without hindering contact with the built environment or a place's capacity. Therefore, an upper limit of 10 - 15 people per minute per square meter on streets and sidewalks with two-way walking traffic should not be exceeded. This is in order to maintain an overall accepted density of people. Areas with lower pedestrian flows therefore require less street width (Gehl 2011, p. 133-134).

Material use
Since pedestrians are in direct and close contact with their environment, the physical aesthetics of an area are the key features that get people to use an area. Examples of these features are

the chosen ground materials, overall conditions of the path and unevenness of the terrain (Gehl 2011, p. 135). Cobblestones and loose materials, such as sand or gravel, might prove dangerous for pedestrians with walking difficulties, wheelchairs or strollers. The same applies for the use of stairs to overcome changes in altitude, ramps or smaller detours is advised over the use of stairs (Gehl 2011, p. 134, 145).

6.3.3 Design Considerations for Cycling

Cyclists are an important active mobility group in car free areas. The preferred use of the bike and which people adopt this mode of transport depend on the cultural perception of the bike in the local context. Because of this, local bike culture needs to be considered at the start of a car free city project (Crawford, Carfree Design Manual 2009, p. 102). Since people are exposed to weather conditions while biking, there will always be seasonal deviations in number of bike trips throughout the year (DTU 2018, p. 1). Deviations in number of bikes on the roads, possible changes in average speed and travelled distances due to the use of e-bikes and new types of bicycles need to be taken into account when planning future infrastructural needs of cyclists.

Networks and connectivity
In order for people to adopt the bike, infrastructure needs to be provided. This includes things like bike lanes and parking spaces (Crawford, Carfree Design Manual 2009, p. 160). Studies on the relation between infrastructure and the use of different modes of transportation have shown that bicycle usage has a stronger correlation with its infrastructure and network characteristics and quality thereof than other modes of transport. These characteristics include the networks' connectivity, completeness and level of separation from other mobility modes (Muhs and Clifton 2016, p. 158). The cycle network should have city wide coverage and provide bike lanes throughout the city (Hunkin and Krell 2019, p. 3-4) (Muhs and Clifton 2016, p.160). Extending the network close or into residential areas is important, because a short distance between home and proper bike infrastructure increases the convenience and attractiveness of biking. The final destination has to be well connected and provide infrastructure for bike users as well. In general, sufficient and secure bike parking, preferably equipped with charging station to facilitate e-bikes, should be provided and workplaces could support biking by providing showers and locker facilities (Hunkin and Krell 2019, p. 3-4).

Safety on bikes
Even though biking is often associated with longer travel times and increased distances (non-direct routes), cyclists are willing to trade-off travel time in favour of comfort and safety on the bike paths (Muhs and Clifton 2016, p. 159). Especially the subjective, perceived feeling of safety is a main factor in people's choices on whether or not to use the bike as a daily transport option (Fahrradportal 2019). If people fear for their lives or feel like they risk injury when riding a bike in traffic, chances of them using their bike are quite low. One way to achieve a higher perceived safety is through bicycle lane design. A shift from bicycle lanes on the road to separated or protected bike lanes increases the feeling of safety. To achieve a better feeling of safety cyclists are willing to take detours and accept bike paths in less good conditions (Fahrradportal 2019). Building a stress-free and safe bike environment requires sufficient space, so existing space might need to be redistributed in favour of biking (Fahrradportal 2019).

Paving
The materials chosen for the bike infrastructure can nudge people into more responsible travel behaviour. Smooth pavement with a good grip is ideal for fast movements on bicycle paths, while uneven pavement will decrease cyclists speed in shared spaces. Conflicts between different mobility users can be prevented by the usage of markings on pavement, signs, signals and by regulations (Crawford, Carfree Design Manual 2009, p. 162-163).

6.3.4 Design Considerations for Public transport

A public transport system requires a city to be dense in order to function optimally (Crawford, Carfree Design Manual 2009, p. 25, 107). To ensure optimal passenger transport, the following goals should be met according to Crawford (Crawford, Carfree Design Manual 2009, p. 132-133):

> *"Short walks to halts, high utilization, frequent service, single-transfer journeys, minimal land occupation, low capital and operating costs, low externalized costs, high energy efficiency."*

If the local transit system is placed on the surface, the travel speed needs to be relatively slow in order to maintain a safe environment on the streets. To accommodate practical issues the service should run frequently with a few minutes waiting time and a visual display of the remaining waiting time (Crawford 2009, p. 165). A high frequency however requires a significant number of passengers on each trip (Crawford 2009, p. 155). Another consideration on accessibility is the possibility to take the bike or mobility scooters onto public transport without facing barriers and causing delays (Crawford 2009, p. 158).

6.3.5 Design Considerations for Cars

Even though a city or area itself is car free, the need for parking is still present. There need to be infrastructure to serve car owners and keep the option available to travel outside the range of public transport and to remote areas. Parking facilities should be provided outside the city and are preferably multi-storage underground garages (Crawford 2009, p. 168). These garages have to be easily reachable by foot or by public transport (Crawford 2009, p. 152).

6.3.6 Design Considerations for Transport of Goods

Like people, goods need to be distributed in and around the car free city as well. Therefore, it is necessary to think about how to get containers and pallets into the commercial- and industrial areas. Crawford suggests a rail-based solution (Crawford 2009, p. 103), although in areas without rail connection he proposes an alternative. Main streets have to be wide enough to facilitate shipping containers used for freight transport and shopping streets could allow regular trucks to enter during designated time periods (Crawford 2009, p. 268). To implement an efficient citywide freight distributions system, that does not bother citizens, the following goals should to be met according to Crawford (Crawford 2009, p. 133):

> *"truck-free city streets, inexpensive delivery of standard shipping containers, fast and economical rail-based freight, full interchange with the global freight network, low capital and operating costs, low externalized costs, minimal land occupation, energy efficiency"*

6.3.7 Summary of Chapter 6.3

This section provided a brief overview of different design considerations that planners have to face when redeveloping areas into car free spaces or when reclaiming space from the car. In these redevelopment projects, liveability aspects have to be considered and implemented through the use of design elements. The design of the infrastructure in an area is vital for a project's potential to increase active mobility users. The main topics planners need to consider are summarized on the next page.

- How the overall street network is to be connected and how the different streets and networks will facilitate accessibility for different user groups and necessary services (emergency vehicles, public transport etc.).
- How safety and perceived safety will be ensured in the entire area.
- How an interesting and appealing environment is ensured in order to support active mobility.
- How the public transport system can be improved.
- How to cover remaining car users' needs and where to place the necessary car infrastructure.

Apart from these broader topics which need to be considered, this chapter also highlighted some best practices and creative alternatives on how to create a liveable cityscape. These are listed below.

Safe Urban Environment

- A dense, mixed-use area discourages criminal activities because it invokes activity throughout the day. A lot of windows facing the street and avoiding garages at ground level enhances social security.
- Clear street design, with markings on the pavement, signs and signals, nudges users into desired behaviour.
- Designated pedestrian crossings and separated bicycle paths increase the feeling of safety.

Accessibility

- Pavement material needs to be suitable for people of all ranges of physical ability.
- Stairs need to be omitted and ramps or detours should be used instead.

City Streets

- Car lanes should be as narrow as possible.
- Main streets need to be wide enough for the transportation of goods into commercial areas.
- In order to minimize delivery vehicles impact on citizens, limited delivery times can be used.
- Cars should be parked in underground multi-story garages that are well connected to the city centre by public transport or lie within walking distance thereof.

Network Planning for Active Mobility

- Ensure connections for active mobility to services that provide daily needs and public spaces.
- Plan services in short proximity to residential areas and use of direct routes for active mobility.

Bike Infrastructure

- Create comfortable and safe bike infrastructure, because cyclists will accept a longer travel time if their trip is more comfortable and safer.
- Use smooth paving on designated bike paths and uneven paving in shared space to reduce cycle speed.
- Bike infrastructure needs to accommodate both cargo bikes, hand bikes for people with disabilities, e-bikes and normal bikes.
- Popular destinations need to be well connected to the bike network and provide parking facilities.
- Widened bike lanes can support use by emergency vehicles.

Pedestrian Infrastructure

- Create winding walkways with greenery and seating areas that do not block pedestrian flow.
- A generally accepted walking distance is 400 - 500 meters or 5 - 10 minutes walking time. Although longer travel times and distances are accepted if the environment is appealing.
- A maximum of 15 people per minute per square meter of walkway ensures comfortable density.

Public Transport

- Stops within walking distance of residential areas as well as facilities are required.
- Lines with high frequently make public transport more useable, but this requires a high population density.

6.4 Best Practices for Reclaiming Car Space

Liveability in regard to infrastructure is closely connected to both safety and pollution. These challenges pressure more and more cities and areas towards improving neighbourhoods by reducing, or even banning, cars in their urbanities. This is necessary in order to mitigate liveability challenges their citizens face. This sub-chapter describes some of the best practices for reclaiming space from the car with the intention to give it back to the people. All cases focus the creation of liveability through a transition away from the car. The cases have had their solution implemented and have proven results. This does not mean this are all cases present in the world, just the ones that provide adequate information on lessons learned. They will be used in chapter 7 to create a tool for planners and municipalities to inspire them and help them transition into more liveable and less car dependent future for their citizens.

6.4.1 The Case of Barcelona

Image 14: Barcelona (Maix 2007)

Barcelona is one of the biggest cities in Spain and is situated on the eastern coastline of the country. The city has a little over 1.6 million inhabitants (PopulationStat 2019) and was struggling with its city planning because of an increase in tourism, gentrification, foreign speculation and cars (Roberts 2019). As a solution they are implementing superblocks throughout their city. These are organized building blocks of approximately 400 x 400 meters that do not require major physical changes in the environment (C40 cities 2018), but diminish car traffic in the residential areas of the city by about 58% (Bravo 2019). Roads on the perimeter of the block facilitate cars and other vehicles that are passing through, while the inner areas of the superblock encourage social activities and active modes of transportation. This diminishes pollution and increases road safety (C40 cities 2018). Five superblocks have been implemented so far and 500 more are planned. Creating superblocks is a gradual process that involves a lot of citizen participation and tactical urbanism (Roberts, Barcelona wants to build 500 superblocks. Here's what it learned from the first ones. 2019). For more in-depth information on the Barcelona case, consult the factsheet of Barcelona in (Appendix 2).

6.4.2 The Case of Dunkirk

Image 15: Dunkirk (Maix 2007)

The metropolitan area of Dunkirk consists of 17 municipalities and is situated in the north of France on the Belgian border. It also has a ferry connection to Dover in England and the population of the area is 202.000 (Communautes Urbaines 2015). Since 2018 the people are able to make use of a completely free public transport system (Fowler 2019, p. 5). Investments in infrastructure were possible by cancelling the construction of a new sport arena and relocating the money to the public transport system (Modijefsky 2018). Operating costs were 352.5 million DKK per year and only 10% of this amount was covered through ticket sales (Willsher 2018). The increase in operating cost, due to more lines and more frequent connections, and the loss of ticket sales was covered by increasing the payroll tax by 0.5%. This was done so the cost would not befall the households in the area (Fowler 2019, p. 5). For more in-depth information on the Dunkirk case, consult the factsheet of Dunkirk in (Appendix 5).

6.4.3 The Case of Freiburg

Image 16: Freiburg (Maix 2007)

Freiburg is a city with 230.000 inhabitants situated in the south of Germany near to the French and Swiss borders (City of Freiburg 2020). They transformed the district of Vauban into a neighbourhood that focusses on sustainable living and mobility. Reducing private car usage and ownership was one of the targets (Stadt Freiburg 2012). Vauban describes itself as being car reduced and is not completely car-free. However, it is not allowed to create private parking areas on properties on the main street of Vauban. Households in possession of a car are obligated to purchase parking space at one of the two parking garages in the vicinity. Vauban had 85 registered cars per 1000 residents in 2012, while the city of Freiburg in general reported 495 private cars per 1000 residents (City of Freiburg 2012). In order to make people less reliant on their car, Vauban has been connected with the light rail and offers a wide range of everyday facilities like shops, schools and doctors (Plattform autofrei/autoram wohnen n.d.). Unique to this case is the use of a local association, called "Forum Vauban", as an intermediate. They are mainly responsible for citizen participation and implementation of social and cultural structures (Forum Vauban e.V., DLR, Oeko-Institut e.V. 2003, 63). The total process costed 750 million DKK (Stadt Freiburg im Breisgau 2014, p. 62-63). For more in-depth information on this case, consult the factsheet of Freiburg in (Appendix 14).

6.4.4 The Case of Ghent

Image 17: Ghent (Maix 2007)

The city of Ghent is situated in the west of Belgium, close to the Dutch border. It is a city with nearly 260.000 inhabitants that completely restructured transport in its city centre (IVA Mobiliteitsbedrijf and Transport & Mobility Leuven 2019, p. 21). They limited the ease of car use within the area by using filtered permeability and a ring road around the centre. While public transport, cyclists and pedestrians can take a direct route. Amongst other things, they expanded car-free areas and added new ones in the densest parts of the centre (Stad Gent 2016, p. 70 - 82), separated the bike infrastructure from the cars (Stad Gent 2016, p. 25 - 27) and freed up bus routes by strategically placing barriers that prevent cars from crossing neighbourhoods (Stad Gent 2016, p. 29). Bike usage increased by 60% (Gent 2019), public transport has become faster, 6% more people are on the shopping streets and there is 32% less time loss in traffic (IVA Mobiliteitsbedrijf and Transport & Mobility Leuven 2018, p. 47, 87, 108). For more in-depth information on this case, consult the factsheet of Ghent in (Appendix 12).

6.4.5 The Case of Houten

Image 18: Houten (Maix 2007)

The city of Houten is situated in the central part of the Netherlands. It is a city with 47.000 inhabitants (AlleCijfers 2020) and has been designed around the concept of filtered permeability. It therefore has a separated and more expansive cycling network than it has general roads. There are 130 kilometres of cycling paths in the small city (Foletta 2014, p. 48). In order to create space for this, Houten had to reduce the space for cars. Direct travel between neighbourhoods by private car is impossible as cars always have to revert to a ring road. By creating this ring road around the whole city and creating just one access point for each neighbourhood, the required space for cars was drastically reduced. Unlike private cars,

emergency services, public transport and active modes of mobility can cross borders between neighbourhoods seamlessly. The bike has become the fastest mode of transport within Houten because of this (Foletta 2014, p. 48). For more in-depth information on this case, consult the factsheet of Houten in (Appendix 13).

6.4.6 The Case of Kaohsiung

Image 19: Kaohsiung (Haha169 2009)

In 2017 Taiwan hosted the EcoMobility World festival in the Hamasen district of the city Kaohsiung, a city with 2.7 million residents (ICLEI, A 2017). The festival was a car-free month for everyone that either lived in the area or desired to enter it. In order to facilitate this festival, the government supplied the citizens of Hamasen with free bikes, free public transport, a new light rail line, e-scooters for rent, an e-carsharing service and subsidies for purchasing more sustainable modes of transport (ICLEI, A 2017) (ICLEI, B 2017) (ICLEI, C 2017). After the trial period ended, 67% of the residents in the area reported they will continue to use more sustainable modes of transport (ICLEI, A 2017, 14). The city of Kaohsiung started involving citizens in the process of organizing 22 months before the start of the EcoMobility festival. In the end people adopted more sustainable mobility practices, there was a significant increase in public transport use and 40 businesses enlisted for sustainable freight service (ICLEI, A 2017, 7). For more in-depth information on this case, consult the factsheet of Kaohsiung in (Appendix 6).

6.4.7 The Case of Oslo

Image 20: Oslo (Maix 2007)

The city of Oslo is situated in the south east of Norway and has approximately 695.000 residents (Statistics Norway 2020). They have ambitious climate goals for 2020 and 2030. Within the city the goal is to cut back emissions by 36% and 95% respectively before those years have passed. This reduction is compared to emission levels of 1990 (Oslo Kommune, 2019). In order to reach these goals, the city applied car reducing measures in 2017. A car free city centre was introduced as part of this and extensive investments in public transport were made. By creating 60 kilometres of new bike paths, it became a much more viable transport option for citizens, as safety increased. The reclaimed space from the car has been returned to the people as parks, squares and alcoves in which social activity can take place (Oslo Kommune, 2019) (Oslo Kommune 2020) (Oslo n.d.). For more in-depth information on this case, consult the factsheet of Oslo in (Appendix 8).

6.4.8 The Case of Pontevedra

Image 21: Pontevedra (Maix 2007)

The city of Pontevedra is situated in the northwest of Spain and has 65.000 citizens that live in its urban centre (Council of Pontevedra 2017, p.2). The city council views public space as a part of their citizens private sphere, in which social activities should be enjoyed (Council of Pontevedra 2017, p.8). Space from the car was reclaimed gradually through dynamic development in order to realize full potential (Council of Pontevedra 2017, p.7,22). This case has been discussed in the framework and therefore either chapter 2.5 of the framework or the factsheet of Pontevedra in (Appendix 9) can be consulted for more in-depth information on this case.

6.4.9 The Case of Vitoria-Gasteiz

Image 22: Vitoria-Gasteiz (Maix 2007)

The city of Vitoria-Gasteiz is situated in the north of Spain and has 250.000 residents (Eustat, 2019). In 1976 it introduced its pedestrianized, car-free zone in order to reclaim space from the car. In 2008 it was decided that this was not sufficient and they were going to implement superblocks throughout the city in order to reduce the environmental impact of the city, improve accessibility and connectivity, increase road safety, increase the diversity of activities in public space and promote the use of public transport. They created an adaptable model that can adjust to the current physical state, political willingness and financial means within an area. Less cars, less noise, less pollution, more public transport use and 29% more public space for people are among the end results of the superblock implementation. For more in-depth information on this case, consult the factsheet of Vitoria-Gasteiz in (Appendix 3).

6.4.10 The Example of Fes el Bali

Image 23: Fes (Maix 2007)

The Medina of Fes el Bali lies within the city of Fes. It is situated in the north of Morocco and has 156.000 residents (GeoNames 2015). The medina is assumed to be the biggest car-free urban area in the world and is therefore an interesting example to look into (Braeuninger, et al. 2012, p.117). It has grown to be car-free over the ages and due to its status as UNESCO World heritage this is not allowed to change. It is a walkable city that can be crossed fully in 30 to 45 minutes (Essbai 2015). The design and philosophy of the medina are hard to comprise into comprehensible guidelines for planners, however there are characteristics that make the medina car-free by nature and there is an interesting hierarchy between the streets that could be inspiring. For more in-depth information on this example, consult the factsheet of Fes el Bali in (Appendix 15).

6.4.11 The Example of Zermatt

Image 24: Zermatt (Maix 2007)

The town of Zermatt lies in southern Switzerland, next to the Matterhorn mountain. It has nearly 5.500 inhabitants (Einwohnergemeinde Zermatt 2019) and banned combustion powered cars in 1931 in order to protect the quality of life of its citizens (Bundesamt fuer Raumentwicklung 2004, p.8). There are about 500 electric vehicles in Zermatt, although none of them are privately owned (Matterhorn Chalets 2020). Private cars need to be parked in a neighbouring village and Zermatt is reachable by e-taxi, train and e-bus from there (Zermatt Tourism 2020). This means that the touristic town of Zermatt creates parking issues in a neighbouring village. Because Zermatt was a very early adopter of banning polluting vehicles it is an interesting example to review, but the overreliance on another town as well as the touristic nature of the town do not make it a good case for urban planning in a more usual context. For more in-depth information on this example, consult the factsheet of Zermatt in (Appendix 16).

6.4.12 The Initiatives

The main ideas from the aforementioned cases have been deducted from their respective material in order to provide a better overview of what the main used initiative concerns and provide insight in the lessons learned of multiple cases. The initiative sheets are fully based on the cases and created through the analysis thereof. There are five initiatives in total and they are listed below. For more information on these initiatives, consult the appendixes.

- Filtered Permeability (Appendix 10)
- Free Public Transport (Appendix 4)
- Superblocks (Appendix 1)
- Walkable City (Appendix 7)
- Woonerf (Appendix 11)

This is not an encompassing list of all the initiatives that are used in the world, but these initiatives all have proven results and a reflection on the process of implementation. The lessons learned are vital to be eligible for use in this thesis, because otherwise there is just speculation. On the initiative sheets there is a table that shows the impact of the initiative on the six pillars of liveability and the argumentation for this can be found in Appendix chapter 42.

6.4.13 Summary of Chapter 6.4

Within this chapter different cases around the world have been explored in order to provide insight into the best practices of reclaiming space from the car and creating a modal shift. The lessons learned from all cases is presented in their respective factsheets in the appendix document. The following cases have been reviewed:

- Barcelona
- Dunkirk
- Freiburg
- Ghent
- Houten
- Kaohsiung
- Oslo
- Pontevedra
- Vitoria-Gasteiz

Honourable mentions were included for the examples of:

- Fes el Bali
- Zermatt

Image 25: Used cases (except Taiwan) (Maix 2007)

The main ideas of these cases have been reworked into initiative sheets that provide a broader overview of the do's and don'ts in regard to their respective implementations. The initiative sheets can be consulted in the appendix document. They concern:

- Filtered Permeability (Appendix 10)
- Free Public Transport (Appendix 4)
- Superblocks (Appendix 1)
- Walkable City (Appendix 7)
- Woonerf (Appendix 11)

6.5 Conclusion

Chapter 6 started with the goal to formulate an answer to sub-question 2. This sub-question reads as follows:

"What are the main design considerations for liveable urban space and which best practices for transitioning into car free cities are there?"

This sub-chapter formulates a reply to this sub-question, but it is a multi-legged question that cannot be answered in a single sentence. It starts out with a reflection on international guidelines for liveability, followed by how local liveability is measured, which design considerations have to be made by planners and what the best practices are regarding reclaiming space from the car and creating a modal shift.

The Sustainable Development Goals (SDGs) and the New Urban Agenda (NUA) are the most important international frameworks regarding liveability. They provide guidelines and targets in order to improve sustainability, liveability and well-being in the urban environment. SDG *11: "Sustainable cities and communities"* is the central goal for urban development. However, there are other goals that need to be considered in regard to this topic and they are listed below.

- SDG 3: Good Health and Well-being
- SDG 9: Industry, Innovation and Infrastructure
- SDG 10: Reduced Inequalities
- SDG 13: Climate action
- SDG 15: Life on Land
- SDG 17: Partnerships for the Goals

The NUA highlights the importance of international cooperation to make a swift and qualitative shift towards sustainable urban environments. There is a key role within its strategy for inclusive and integrated people-centric planning for all ages and genders. The following actions need to be considered when designing urban space:

1. Delimiting the urban space to define project boundaries
2. Integrating different levels and sectors of governance
3. Including a multitude of actors
4. Considering trade-offs and synergies with other sectors and daily life
5. Making use of indicators for measurement

Local liveability measurement is important for operationalizing liveability for planners. Liveability indexes do not consider locality and are therefore useless in this regard. The 12 quality criteria of liveable urban space from Jan Gehl are recommended to assess local liveability. They are visible in Image 26 on the next page.

Becoming a completely car-free city in the near future is unfeasible and planners should focus on diminishing car use in general and limiting the space cars have within an urban environment in order to eventually transition into a car-free city.

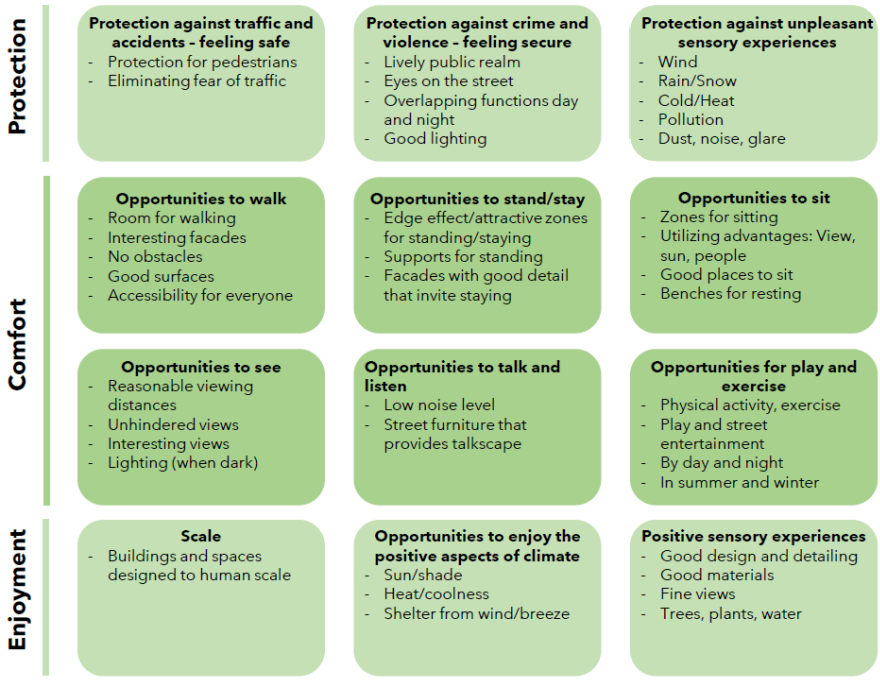

Image 26: The 12 quality criteria for liveable urban space (based on (Gehl, Gemsøe, et al. 2006, p. 107))

The design of the infrastructure in an area is vital for a project's potential to increase active mobility users. The main topics planners need to consider are summarized below.

- How the overall street network is to be connected and how the different streets and networks will facilitate accessibility for different user groups and necessary services (emergency vehicles, public transport etc.).
- How safety and perceived safety will be ensured in the entire area.
- How an interesting and appealing environment is ensured in order to support active mobility.
- How the public transport system can be improved.
- How to cover remaining car users' needs and where to place the necessary car infrastructure.

Apart from these broader topics which need to be considered, there are best practices and creative alternatives on how to create a liveable cityscape within the following topics:

- Safe urban environment
- Accessibility
- City streets
- Network planning for active mobility
- Bike infrastructure
- Pedestrian infrastructure
- Public transport

Lastly, the best practices regarding reclaiming space from the car and inducing a modal shift have been reviewed. Several initiatives have been deducted from the lessons learned in these cases. The cases and initiatives can be consulted in the appendix document.

7. Creating a Planning Tool

The focus of this chapter lies with answering sub-question 3, which reads as follows:

"How can the information from previous sub-questions be used to serve as a planning tool?"

Within this chapter the information of previous sub-questions will be combined to present planners with the necessary lessons learned, considerations and practices for reclaiming space from the car. This bundle of information will become a tool for planners to work with during their everyday work concerning liveability. The following topics that have been analysed in this research are implemented in the tool:

- Common reasons behind car dependency — Chapter 5.1
- Behavioural change through change of habits — Chapter 5.2
- The concept of liveability and its design considerations — Chapter 6.3
- Examples and cases of car reducing initiatives that increase local liveability — Chapter 6.4

With offset in the summaries of these topics in previous chapters, the planning tool is built. This chapter focusses on the process and consideration from theoretical knowledge to form a tool for Danish urban planners. The final output, meaning the tool itself, is presented in the (Appendix p.3).

7.1 Structure and Aim of the Tool

The new planning tool consists of a reading guide followed by two main parts. The first part presents general recommendations and design considerations based on the empirical studies in the report (Chapters 5.1 through 6.3) and the second part presents the created initiatives and cases of chapter 6.4.

The aim of this tool is to inspire urban planners by giving them real world cases with proven results from which they can gather ideas and review initiatives. This gives them the opportunity to adapt initiatives to local context with a steppingstone for an implementation strategy. This combination is important to account for possible barriers to change, factors that have influence on the success of a project and to learn from mistakes already made by others. The cases and initiatives are therefore not a "Plug & Play" model but meant as a "Mix & Match" concept, in order to account for local context and possibilities.

7.2 The Reading Guide

In order to make the use of the tool as easy and straight forward as possible, there is a reading guide included with the tool. It is not necessary to read this part to use the tool, but to get the most out of it and bypass possible application errors it is highly recommended. The reading guide informs the reader about which parts the tool consists of and further details on the factsheets. Three key points are especially important to highlight in the reading guide:

- Explanation of the information displayed on the factsheets
- The differences between initiative- and case sheets
- That the presented information and initiatives are not meant as a copy-and-paste solution for Danish municipalities

It is very important to note that these recommendations, initiatives and cases will not fit naturally into a Danish municipality without adjustments for local context. Initiatives can be mix & matched and scaled up or down to fit the local Danish context. There is some guidance on the considerations that planners need to make, but the adjustment will also need some input and skill from the planners themselves.

The heart of the tool is formed by the initiatives and cases, so it is important to explain their content and the visualisation. The guide explains the design of the factsheets and briefly list all the boxes and graphs displayed on the sheets. For an even better understanding both factsheet templates are shown. The reading guide of the tool is available in (Appendix p.3).

7.3 Theory and Design Considerations

Within this thesis a lot of theory has been reviewed and through analysis, relevant information for planners has been deducted. This relevant information is presented in the tool to provide insight in the theory behind the tool and the design considerations they need to make. It is based on the conclusions and summaries of the various chapters in this report and for a more elaborate explanation of the theories and considerations this report needs to be consulted. Since the tool is attached to this publicly available Master Thesis, it should not be a problem for readers to find relevant information in this report or the attached references.

7.3.1 Urban Liveability

Chapter 2.1 in the framework of this research made clear that liveability is not a concept which is clearly and sufficiently defined. It is a concept which is highly dependent of the subjective perspective of individuals and therefore definitions and targets vary. Within this research an operational description of liveability is posed and the terms placement in the national and international context is shown. Especially the working definition of liveability, used in this research and tool, are of importance for the tool and its readers. The theory part of the tool contains a short explanation of the operational explanation of liveability, by explaining the six main aspects that constitute it. This explanation is placed at the start of the theory and general recommendations chapter, since improvement in local liveability is the overall goal of the tool.

The global political agenda has been focussed on incorporating urban liveability in its policies and therefor the liveability concept and its connection with the Sustainable Development Goals and New Urban Agenda is explained in the tool. The focus is not on educating planners on the correlation, but instead to give them valuable arguments at hand when advocating for more liveability in their municipality. Many municipalities as well as private planning agencies work with the SDGs in their strategies and projects, therefore highlighting which goals are positively influenced by an increase in liveability can be useful in future political discussions. The same reasoning is applicable for the NUA.

More hands-on knowledge on liveability and a specific way of assessing liveability on a local level is found within Gehl's work on designing and planning cities for citizens. This information is useful when assessing an existing places liveability and human scale and in the considerations for new projects. Therefore the 10 key elements of urban space dedicated to citizens and the 12 quality criteria for liveable spaces should be considered in both existing and future planning. These guidelines can be consulted in chapter 6.3.7 of this report

7.3.2 Design Considerations for Urban Liveability

A well-considered infrastructure can have a major influence on initiatives outcomes. Hence findings from this research on general design considerations and solutions in car free areas are a necessary part of the tool. In the tool the overall considerations planners have to consider before initiating changes are presented first. These considerations are concerned with the "bigger picture" of the initiative itself and the correlation between the initiative and surrounding environment. These considerations are followed by actual design solution which can be used to address the overall questions. In the listing information on the following topics can be found: Safe urban environment, accessibility, city streets, network planning for active mobility, bike infrastructure, pedestrian infrastructure and public transport are presented. These guidelines can be consulted in chapter 6.3.7 of this report.

7.3.3 Car Dependency and Habitual Change

Within chapter 2.3 of the framework and chapter 5.1, all pillars of car dependency have been discussed. Since these chapters study car dependency on a general level and do not take the local context of Danish municipalities into account, these findings are only presented in a listing of common reasons for car dependency. They give a useful overview for common drivers for car use, without the need to analyse the local situation at hand.

Changing the habit of car use, especially due to the psychological factors, Dewey's considerations on habits and habitual change are useful knowledge for planners. They stress, how important it is to address all different kinds of car dependency in initiatives, instead of solely focussing on infrastructural changes. The information on habits and how to change these stresses how important social institutions and stakeholder involvement are in order to achieve the desired shift away from car dependency. Through this information, planners will get a better understanding of which factors keep the current car dependent system in place and why citizens are responding to change in the way they do. These guidelines can be consulted in Appendix page 9 through 16.

7.3.4 Lifestyle and Health

A sedentary lifestyle has a negative impact on a person's health but nevertheless more than half of the trips (59%) in Denmark are made by car compared to 35% of the trips by active transportation, while the latter is healthier. A reduction in numbers of cars will result in various benefits and the urban quality of life as well. Health benefits can be useful arguments when advocating for a better liveability in urban areas by reducing the numbers of cars and therefore these arguments are present in the tool.

The WHO guidelines on adequate levels of activity are included, as well as the lack of activity of average Danish teenagers and adults. Some citizens might not be aware of their lack of physical activity and can be motivated to use active means of transport if they gain more insight into the benefit for their health. People, who are physically active might be even more motivated to stay active as well. The health benefits gained through physical activity are presented to be used as arguments to create behavioural change from within groups of citizens and other stakeholders.

An active lifestyle can be further supported through adequate infrastructure. A list of factors hindering people's will to use active means of transport is presented as well. That way planners, or other people working with infrastructural design, can avoid these pitfalls in new projects. These can be consulted in (Appendix – Tool – General Considerations).

7.4 The Factsheets

The presentation of initiatives and cases is the part of the tool that is created to inspire and hand planners' ideas they can user. It provides information and short evaluations of successful real-world cases, which manage to increase citizens liveability through local car reducing measures. An overview of the cases including their geographical placement, the concept they used and further key points are presented in chapter 6.4. If the reader is interested in further details on one or all cases, more in-depth information and a short evaluation of the initiative is provided on the factsheets which can be consulted in the appendix document (Appendix 1 - 16).

Since the tool is meant for inspirational and communicational purposes, it is important to visualise information in a clear way so desired information is easy to find. In order to present the spate of useful information in an appealing way, the case-based findings are presented on factsheets. These sheets are categorized in initiative sheets and case sheets. To give a fast overview of information and achieve easy readability, both types of factsheets use different colours within their templates. Initiative sheets are blue, while case sheets are yellow. That way the design underlines the difference between initiative and case sheets. Both templates make use of info-boxes.

The initiative sheets are blue in colour and used to outline the overall concepts of car reducing initiatives, measures, known barriers and supporting factors, examples from around the world and the impact on liveability. All initiative sheets are designed to cover two pages with information, including a QR code for further references and the used sources.

The case sheets focus on initiatives which have successfully implemented car reducing measures to improve local liveability. They contain information on the main objectives, implemented measures, known barriers and supporting factors, considerations on transferability and lessons learned. They also include a QR code for further references and the used sources.

In the tool itself the initiatives are presented first, followed by the cases that are related to the initiative. With this order, the reader can skim or read the initiative sheet and if the concept peaks the readers interest, the following cases will provide further information and insights. If the concept seemed less useful, the reader can jump straight to the next initiative sheet.

7.5 Conclusion

Chapter 7 started with the goal to formulate an answer to sub-question 3. This sub-chapter answers that question, which reads as follows:

"How can the information from previous sub-questions be used to serve as a planning tool?"

Sub-question 1 and 2 presented a lot of different information and compiling that into a comprehensible package is essential in order to function well as a tool. The creation of a reading guide helps the reader understand the way information is presented and the things they need to look out for. By presenting the theoretical base of the tool first, the reader gets acquainted with concepts and context before they are confronted with these concepts.

Including design recommendations for planners is a must, because designing is what they do. However, an integral part of design is "selling" it. Politicians are hard to convince when they feel a project will not foster them public support and therefore, they require arguments for different initiatives. These arguments are presented in the tool by combining the design recommendations, health impact of an active lifestyle and lessons learned in cases.

The information is compiled to such density that can become overwhelming if it is not presented in an easy to understand and visually appealing way. Therefore, the choice has been made to construct factsheets that include pictures and are no longer than two pages. By further differentiating between the colour usage of initiative sheets (blue) and case sheets (yellow), the reader can easily distinguish the sheets.

By doing all this, the planning tool is able to inspire, provide steppingstones, make sure mistakes that were previously made are avoided and provide arguments for projects concerning the enhancement of liveability through reclaiming space of the car.

8. Reflection on the Tool

All sub-questions have been answered but there was opportunity to include the knowledge of municipal planners within the thesis. Interviews were held with municipalities in Denmark in order to gather information on the way the target audience views the tool. Interviewees were given a preview of carefully chosen car-reducing initiatives and cases with positive effects on local liveability. They reviewed the material in order to provide feedback on them. The set-up of the interviews is presented in this chapter and the city planners' evaluation of the presented initiatives, their comments, critiques and requests for further information are used to reflect on the tool that was created in the previous chapter of this thesis.

The Danish municipalities involved in the interviews are Frederikshavn-, Hjørring-, Randers- and Skanderborg Municipality. Further information and gatherings from the interviews can be consulted in the Appendix. The following documents are included:

- The sent interview material in English (Appendix 34)
- Interview questions are available in (Appendix 36)
- A combined analysis of all four interviews in English (Appendix 37)
- Interview notes taken during the videocall in Danish (Appendix 38-41)

8.1 Interview Setup

Since the final output of this thesis is an inspirational planning tool that is mainly aimed at Danish municipal planners, their input and further requests for the planning tool are crucial information and need to be considered in further development of the tool. Well before the actual video interview took place, interview correspondents were presented with the interview questions and asked to review parts of the planning tool. The sent material can be reviewed in (Appendix 34) and included:

- A **reading guide** including a short description of the aim of the tool and how to read the factsheets.
- The **initiative sheets** on: Walkable City, Woonerf, Superblock, Filtered Permeability and Free Public Transport.
- The **case sheets** on Oslo, Pontevedra, Vitoria-Gasteiz, Houten, Ghent, Dunkirk, Barcelona, Freiburg-Vauban and Kaohsiung.

Interviews need to be scheduled ahead of time and the tool was not fully finished at the time they were held. The municipalities reviewed a slimmed down version of the reading guide, which was devoid of a theoretical framework besides an explanation on liveability and the factsheets that they reviewed had a marginally different layout. All initiative- and case sheets except for the examples of Fes el Bali and Zermatt were sent to be previewed by the municipal planners. Only finished, well written information could be sent in order to gather qualitative feedback. Although the work on the first part of the tool, the general considerations and useful arguments, was not finished when the material was sent, it was possible to get feedback on these topics from the municipal planners through the first six questions of the interview. The interview schedule was tight since all interview questions including the review of the material had to be covered within 1 - 1.5 hours conversation.
These interview questions can be reviewed in (Appendix 36).

8.2 Main Takeaways from Interviews

Condensing all the useful information from four interviews that span five hours of conversation into a comprehensible piece for a report that covers everything is nearly impossible. This chapter will therefore only present the main takeaways of the interviews and a more elaborate explanation is included in (Appendix 37).

Despite the fact that the four municipalities all had different mobility strategies, they reported the following similarities within the interviews:

- Car dependency is growing in every interviewed municipality.
- None work with an operational version of liveability.
- All include citizens and external stakeholders in the planning process
- Previous projects have shown that citizens support active mobility initiatives.
- All like compactness of sent material and consider all presented information useful.

These statements underline the value the created planning tool can add for municipal planners. Almost all the vital concepts that are highlighted within the tool are touched upon: car dependency, liveability, citizen participation and citizen support are accounted for.

In general, the interviewees desired that the tool would eventually contain the following information:

Overall information:

- Definition of liveability to establish a common understanding of the term.
- Overall recommendations on car free initiatives, regardless the local context.
- Further information on behavioural change to identify possible initiatives.
- Initiatives which can be mixed-and-matched and are suitable for all municipalities regardless their current work on car-reducing measures.

Additional information:

- The cases local context before the initiatives started.
- Benefits for all stakeholders including local businesses.
- Information on the planning- and implementation process including possible pitfalls.
- Step by step guide on smaller initiatives with their budget requirements to gradually transition into the final solution presented as the initiative.
- Include small scale initiatives for smaller budgets.

Factsheets about:

- Initiatives focussing on behavioural change
- Contemporary initiatives
- Small-scale projects
- Cases based in Denmark

Due to time limitations it was not possible to go back and reiterate on the planning tool, but this list of desired information can serve as input for future research that seeks to improve upon the created planning tool. These findings as well as the statements listed on the next page will be reflected upon in the next chapter.

Other interesting statements that were made are:

- The political agenda and urban planners' visions do not always align
- Car reduction polarizes citizens and therefore voters
- The municipalities had very different ideas about their mobility futures
- Skanderborg reported to be working on some of the initiatives without knowing it already existed.
- Budget is very limited and only allows very small scale, cheap and effective urbanism.
- More information on how to structure citizen participation is desired.

8.3 Reflection on the Tool

During the interviews many points were raised that could further enhance the tool, but during the research process there were also interesting dilemma's and takeaways that are worth discussing. All of these will be discussed within this chapter.

Overall municipalities were positive about the content that was presented, but there were key elements missing for them make optimal use of it. Some of these elements were easy to include and have been adjusted in the final version of the planning tool, but the more time-consuming additions could unfortunately not be changed within the time between the interviews and the deadline of this research. The requests that have been implemented are:

- The inclusion of an operational definition of liveability
- Overall design recommendations for liveability
- Information on behavioural change
- Clearly stating the mix and match nature of the tool, because the cases and initiatives do not need to be fully implemented in order to foster success

From the additional requested information, a couple of other things stand out:

First, the local context of a place before an initiative was implemented, the overview of benefits for all stakeholders, detailed information on the planning process are things that go into so much detail that even the public municipal documents lack this information. In order to acquire this information a close collaboration with the case areas has to be established. This is a time-consuming process and was not viable within the timespan of this thesis but can be a topic for follow up research.

Second, the request for smaller step initiatives has been requested. There were cases like that sent out to the interviewees. For example, Barcelona works with small steps and temporary, tactical urbanism in order to create cheap and successful solutions. Unfortunately, this message is not clearly conveyed because the case sheet only presents the end result of their efforts. Most likely this can be attributed to the presentation of the case, but in-depth elaboration is unfortunately hard on a two-page factsheet.

Third, small scale, small budget initiatives were requested. These initiatives are hard to come by, because they usually do not have an extensive list of results that can be used to provide lessons learned, barriers to change and supporting factors. These cases are important in a Danish context, because most municipalities are relatively small and have a corresponding budget. Acquiring this information is, again, time consuming and a lack of time has prevented inclusion of these cases and can be a topic for follow up research.

A statement that was made multiple times during the interviews is that planners' visions and political agenda's do not always align. This is due to the fact that the political agenda tries to avoid polarizing initiatives in order to foster the maximum number of votes, while planners that try to shift away from the car propose an initiative that does just that. There will be people who strongly oppose the initiatives, but also strong supporters. Through the use of the theory on behavioural change this can be mitigated a bit, but the political agenda and political courage are thing which are not touched upon deeply. These are very complicated facets of urban planning that influence the created tool but require a full research paper on their own to make funded claims about. This is a possible topic for future research that would help planners immensely to push their vision and therefore the created planning tool.

In order to address political courage, COWI has created a mobility game that citizens, planners, politicians and other stakeholders can play together in order to gain more insight in the desires of other stakeholders, try to achieve and most importantly the thing that drive them. This can lead to more understanding and support. The factsheets can serve a similar role, because they can be discussed or spark conversation and bring different stakeholders closer together because of it.

Planners also requested cases from Denmark, because the local context is assumed to be more similar than cases from abroad. It is quite hard to come by car reducing measures outside of the biggest cities in Denmark however and most planners are already familiar with these cases. It is a possibility to work together with the interviewees to make them the first Danish cases by establishing a network for knowledge sharing, that generates its own data and converts that into cases for the tool. This way the tool gets expanded upon with more local cases and it becomes more and more useful for small Danish municipalities.

Interestingly enough, Skanderborg reported to be working on some of the initiatives without knowing it. They were very surprised that their efforts had been tested elsewhere and were delighted to have extra information about the case in order to improve the implementation process and go further ahead than they planned to (Appendix 41.

In chapter 5.3.1 it was established that Denmark has a very high active mobility share compared to the rest of Europe (35% vs. 16%) and a very low public transport share (7% vs. 26%). This provides ample opportunity for active mobility initiatives in Denmark to take hold. Apparently, the Danes prefer to use active mobility over public transport and for short distances (below 4 kilometres) public transport is barely used. This provides opportunity for the constructed tool and future factsheet additions should focus on the implementation of active mobility to capitalize on the health benefits for society. This is a huge opportunity to improve public health.

9. Conclusion

Urban liveability issues have become more and more pressing in recent years and in 2015 made their way onto the global political agenda. Car dependency is one of the things that puts great pressure on liveability. In order to explore the interplay between liveability and car dependency and create a tool that Danish municipalities can use to reclaim space from the car, the following **research question** was posed at the start of this thesis:

"How can liveability strategies be combined as a tool to be used by city planners in order to reclaim space from the car, create more public space for people and transition into car-free cities?"

Formulating a reply to a multifaceted question like this in one go is near impossible. In order to enable the formulation of a proper answer, the following **sub-questions** were posed:

1. Why do people use the car, how can a behavioural shift be induced, and which transport options are commonly available in Denmark?
2. What are the main design considerations for liveable urban space and which best practices for transitioning into car free cities are there?
3. How can the information from previous sub-questions be used to serve as a planning tool?

Now all sub-questions have been answered and a reflection on the tool has taken place, it is possible to answer the research question. The **answer to the research question** reads as follows:

Liveability strategies have to presented as clearly defined initiatives that are explained through examples on a case by case basis in order to provide ample information in order to be useful for municipal planners. They also require a theoretical background, which explains key concepts within the initiatives and general design consideration regarding liveability in order to adapt fully to the local context. All presented initiatives have to focus on dedicating space to other modes of transportation or creating a modal shift away from the car. This way space that was previously occupied by the car can be converted into public space and given back to the people. Becoming truly car-free is not feasible in the near future, because of the infrastructure that connects cities to rural areas and each other, but implementing the presented initiatives is the start of the transition into car-free cities.

The developed planning tool can be consulted in (Appendix p. 3). The most important elements of the created planning tool are:

- A reading guide
- An operational liveability definition
- Overall design considerations for urban liveability
- Theory on behavioural change
- Theory on the relation between active mobility and public health.
- The lessons learned from cases
- Barriers to change and supporting factors for initiatives

10. General Discussion

In this chapter possible weaknesses of the research, the influence of COVID-19 and possibilities for further research are discussed.

10.1 Possible Weaknesses in the Research

Even though the final tool is primarily aimed at municipal urban planners, it would have been beneficial to add further perspectives on the tool and more in-depth qualitative knowledge by interviewing further stakeholders. Through this research, and especially the interviews with the municipalities, it became clear how many different interests are at stake when redistributing urban public space. Citizens, politicians, local business and the municipal planners all have interests and requirements for the public space. Besides these, basic services and infrastructural needs have to be accommodated as well. In this research only the urban planners' perspective was analysed through interviews. In order to expand the tool into one that is more holistic and also useful for other experts, interviews with several other groups of stakeholders would be beneficial. Especially the critical voices coming from the political sector and local businesses could have added a more critical evaluation of the initiatives and cases presented in the tool. Interviews with bigger municipalities like Aarhus and Copenhagen might have changed the final outcome of this report as well, since their geographical and demographical characteristics are different from the interviewed municipalities. However, they fell outside of the scope of this research

Another possible weakness is the lack of on-site knowledge in regard to the provided and reviewed cases. All information is based on carefully chosen third party evaluations, official municipal documents and other online sources. Though, field trips to the recommended areas would have been beneficial to see if the initiatives are still running smoothly, talk to local citizens to hear their thoughts on the matter and get in contact with the local city planners who worked with the projects to get further in-sight in the cases. This way, the research might have covered more critical points and insider knowledge on the factsheets.

10.2 COVID-19 influence

During this research the 2020 COVID-19 pandemic took place. The following disclaimer was provided by the head of the study and the head of the study boards:

"COVID19 and the consequences of the lock-down of society and the university since March 13, 2020 have had influence on which activities that have been possible to stage and carry out as part of the project work. More specifically, this means that activities have been limited to online activities, and that activities such as Lab activities; surveying activities; on-site ethnographic studies and on-site involvement activities have not been possible.
When assessing this project, please bear this in mind."

This disclaimer was followed by a request to reflect on the influence of the COVID-19 situation on the thesis and this sub-chapter provides that. Like most parts of society, this Master Thesis was forced to adapt to the new circumstances defined by the COVID-19 pandemic as well. It primarily influenced on the choice of methods and the corresponding output.

The initial research design included one or several workshops with municipal planners from different Danish Municipalities. In the best-case scenario, planners from different municipalities would join one workshop to discuss different initiatives and cases around the world. The initiatives and cases would have been presented by the students in a short presentation, followed by a plenary discussion about the applicability of the initiatives and cases on a general level as well as in regard to the local municipal context. The students would function as facilitators of discussion without determining the agenda in this plenary conversation between the urban planners. This way the discussions between municipal planners could have developed more freely into other directions than the ones conducted through the video interviews with one municipality at a time and a set of interview questions. The interviews itself were placed quite late in the research process since there was still hope of being able to conduct the desired workshops. The change of interview method meant a change in how to present the material as well. The previous planned presentation was then replaced by the factsheets and a reading guide. The creation of this material meant further postponing the actual interviews, since the urban planners needed to have time to read through the sent material. Nonetheless, the interviews still provided valuable knowledge and the planners had the chance to review the first draft of the tool.

Before the COVID-19 restrictions were put in place, field trips were part of the research process. On these field trips, on-site observations and interviews with citizens should have been held to attain more qualitative information about chosen cases. This necessary information was now obtained through online literature review instead, although it provided less result than on-site visits.

Another minor practical issue this research was facing was the closure of the Aalborg University library. Hence, nearly all sources are online sources or where borrowed before the closure.

10.3 Recommendations for Future Research

Due to the time restrictions of this Master Thesis, some very interesting parts of this field of urban planning have only been mentioned briefly and not been studied in-depth. Especially in regard to the final planning tool, there are some interesting topics to be added.
In the general considerations, notions on how to align the political sector and planning departments visions could have added valuable information. Therefore, future research on increasing liveability through car reduction should look into the power systems in place. The interviews with the Danish urban planners highly indicated, that there are some major barriers in place when dealing with decision making in municipalities. Especially the relation between the planning department and the political sector should be studied. Only when these structures are revealed can future recommendations and initiatives be more target oriented. Hence, planners will have more convincing arguments and tactics on hand to get the political sector on the same page. A formation like this will bring the process of building liveable and people centric urban areas onto a whole new level.

Additions to current initiatives and cases should be made as well as adding more initiatives and cases to the total assemblage. The current cases should be completed by adding the request from the municipal planners. This means, the revised tool should deliver the following information in the factsheets: The cases local context before the initiatives started, highlight benefits for all stakeholders, information on the successful planning- and implementation process including pitfalls to be aware of and point out the smaller initiatives and their budget requirements which gradually merged into the final and comprehensive

solution presented as the initiative. When looking for new cases to add, the planners wishes should be taken into account. Here successful and thoroughly evaluated initiatives on the following areas should be added: Initiatives focussing on behavioural change, contemporary initiatives, small-scale projects and initiatives with small budget requirements and cases based in Denmark.

Especially the cases in Denmark and the small scale, low budget solutions are relevant for smaller Danish municipalities. The local context is assumed to be more similar than cases from abroad, but it is quite hard to come by car reducing measures outside of the biggest cities in Denmark. Most planners are already familiar with these cases as well. It is a possibility to work together with the interviewees to make them the first Danish cases by establishing a network for knowledge sharing, that generates its own data and converts that into cases for the tool. This way the tool gets expanded upon with more local cases and it becomes more and more useful for small Danish municipalities.

Another suggestion for further research and further development of this planning tool is the possibility of using gamification to further develop this tool into a better tool for communication between different stakeholders. Especially in regard to citizen involvement this new twist could be a very valuable addition. Here further inspiration can be found at the "Mobility Game" developed by COWI. Unfortunately, evaluations on their approach are not available for public use yet.

11. Bibliography

Adbelhamid, Mona M., Mohamed M. Elfakharany, and A. M. Elfakharany. 2018. "Reducing Private Cars Dependency to Achieve Sustainable Urban Environment in Congested Cities." *7th International Conference on Modern Research in Civil Engineering, Architectural & Urban Development*. Munich. 13.

Alameri, M. 2011. "The Car Free City Model." *WIT Transactions on the Built Environment* 143-154. https://www.witpress.com/Secure/elibrary/papers/UT11/UT11013FU1.pdf.

AlleCijfers. 2020. Accessed April 16, 2020. https://allecijfers.nl/woonplaats/houten/.

Badiozamani, Ghazal. 2003. "Car-free days: A shift in the planning paradigm?" *Natural Resource Forum* (Blackwell Publishing) 27: 300 - 303.

Bakogiannis, Efthimos, Maria Siti, Avgi Vassi, Georgia Christodoulopoulou, and Charambos Kyriakidis. 2014. "Case studies and sustainable urban mobility research schemes: A communication channel among researchers and interdiciplinary community groups." *International Journal of Service Science*, 09 30: 42-51. Accessed 05 25, 2020. https://bakogiannis.eu/images/publications/4.5/4.5.14.pdf.

Braeuninger, Prof. Dr. Michael, Dr. Sven Schulze, Leon Leschus, Dr. Jürgen Perschon, Christof Hertel, Simon Field, and Nicole Foletta. 2012. "Achieving sustainability in urban transport in developing and transition countries." *Umwelt Bundesamt*. February. Accessed March 06, 2020. https://www.osti.gov/etdeweb/servlets/purl/21545186.

Bramley, Ellie Violet. 2014. *The Guardian*. December 8. Accessed February 12, 2020. https://www.theguardian.com/cities/2014/dec/08/jan-gehl-make-cities-liveable-urban-rethinker.

Bravo, David. 2019. *Poblenou "Superblock" Barcelona (Spain), 2018*. 3 September. Geopend May 5, 2020. https://www.publicspace.org/works/-/project/k081-poblenou-s-superblock.

Bundesamt fuer Raumentwicklung. 2004. *Autofreie Tage Enstehungsgeschichte, Beispiele und Umsetzung*. ARE.

Burgen, Stephen. 2018. *The Guardian*. September 18. Accessed February 21, 2020. https://www.theguardian.com/cities/2018/sep/18/paradise-life-spanish-city-banned-cars-pontevedra.

C40 cities. 2018. *C40 Cities*. Accessed 02 11, 2020. https://www.c40.org/case_studies/barcelona-superblocks.

Cambridge University. 2020. *Cambridge Dictionary*. Accessed February 7, 2020. https://dictionary.cambridge.org/dictionary/english/liveability.

Christiansen, Hjalmar, and Oana Baescu. 2019. *TU årsrapport for Danmark 2018*. Center for Transport Analytics.

City of Freiburg. 2020. *Bevölkerung und Wohnen*. March 11. Accessed April 15, 2020. https://www.freiburg.de/pb/207904.html.

—. 2012. *Verkehrskonzept*. Accessed 03 12, 2020. https://www.freiburg.de/pb/208744.html.

City Population. 2019. *City Population*. 1 1. Accessed February 21, 2020. https://www.citypopulation.de/en/spain/galicia/pontevedra/36038__pontevedra/.

Communautes Urbaines. 2015. *Communautes Urbaines*. Accessed April 21, 2020. http://www.communautes-urbaines.com/index.php/Dunkerque?idpage=67&afficheMenuContextuel=true.

Copenhagenize. 2019. *01 Copenhagen*. Accessed 03 29, 2020. https://copenhagenizeindex.eu/cities/copenhagen.

Costello, Doug. 2015. *TEDX.* Accessed February 12, 2020. https://www.ted.com/tedx/events/17413.
Council of Pontevedra. 2017. *Concello de Pontevedra.* MArch. Accessed February 21, 2020. http://www.pontevedra.gal/publicacions/fewer-cars/files/assets/common/downloads/publication.pdf.
—. 2017. "Fewer cars more city Pontevedra." March. Accessed March 28, 2020. http://www.pontevedra.gal/publicacions/fewer-cars/files/assets/common/downloads/publication.pdf.
—. 2016. *Pontevedra OK.* Accessed February 20, 2020. http://ok.pontevedra.gal/en/next-steps/.
Crawford, J.H. 2009. "Carfree Design Manual." In *Carfree Design Manual*, by J.H. Crawford, 600. Utrecht: International Books.
—. 2009. *Carfree Design Manual.* Utrecht: International Books.
Danish Ministry of Housing, Urban and Rural affairs, Copenhagen, Aarhus and Sonderborg Municipalities and the Danish Energy Agency. 2014. *Danish Energy Agency.* September. Accessed February 18, 2020. https://ens.dk/sites/ens.dk/files/Globalcooperation/green_urban_denmark_eng.pdf.
Danmarks Statistik. 2019. "Nyt fra Danmarks Statistik, Nr.117." *Danmarks Statistik.* 03 27. Accessed 04 02, 2020. https://www.dst.dk/Site/Dst/Udgivelser/nyt/GetPdf.aspx?cid=28467.
—. 2019. *Stor vækst i antal familier med flere biler.* 08 27. Accessed 04 02, 2020. https://www.dst.dk/da/Statistik/nyt/NytHtml?cid=27286.
Dejlige Days. 2018. *Dejlige Days.* April 10. Accessed May 28, 2020. https://dejligedays.com/2018/04/10/car-sharing-in-copenhagen-and-other-parts-of-denmark/?fbclid=IwAR0NAxHX5l-RegkZ2g7f_Pz4V3mmrTnfS6aqI61AYlUbAEmzZha__J1SR24.
Dewey, John. 1922. „Habit and Will." In *Human Nature and Conduct - An introduction to Social Psychology*, door John Dewey, 24-43. New York: Henry Holt and Company.
Dewey, John. 1922. „The Place of Habit in Conduct." In *Human Nature and Conduct - An Introduction to Social Psychology*, door John Dewey, 14-23. New York: Henry Holt and Company.
DTU. 2018. "Faktaark om cykeltrafik i Danmark 2017." *Center for Transport Analytics - Transport DTU.* Accessed 03 30, 2020. https://www.cta.man.dtu.dk/transportvaneundersoegelsen/udgivelser/faktaark/faktaark-om-cykeltrafik-i-danmark-2014.
—. 2018. "Faktaark om cykeltrafik i Danmark 2017." *Center for Transport Analytics - Transport DTU.* Accessed 03 30, 2020. https://www.cta.man.dtu.dk/transportvaneundersoegelsen/udgivelser/faktaark/faktaark-om-cykeltrafik-i-danmark-2014.
Dyck, Isabel. 2005. "Integrating Home and Wage Workplace." In *Motherhood and Space: Configurations of the Maternal through Politics, Home, and the Body*, by Caroline Wiedmer and Sarah Hardy, 161 - 184. New York: Palgrave Macmillan.
ECA International. 2020. *Global liveability report reveals which cities offer the best quality of life for Europeans abroad.* Accessed 05 22, 2020. https://www.eca-international.com/news/february-2020/global-liveability-report-reveals-which-cities-off.
Einwohnergemeinde Zermatt. 2019. *Einwohnergemeinde Zermatt Einwohnerstatistik.* November 01. Accessed April 20, 2020. http://gemeinde.zermatt.ch/unser-dorf/einwohnerstatistik.

English, Jonathan. 2019. *City Lab.* August 29. Accessed February 11, 2020. https://www.citylab.com/transportation/2019/08/commute-time-city-size-transportation-urban-planning-history/597055/.
Essbai, Sarah. 2015. *Le journal international Archives.* Geopend 03 01, 2020. https://www.lejournalinternational.fr/In-the-heart-of-Fes-getting-to-know-the-medina_a3032.html.
European Commision. 2016. *European Commision.* November 11. Accessed February 21, 2020. https://ec.europa.eu/environment/integration/research/newsalert/pdf/car_free_cities_healthier_citizens_476na1_en.pdf.
Eustat. 2019. *Eustat - Euskal Estatistika Erakundea Instituto Vasco de Estadística.* Accessed 03 07, 2020. https://en.eustat.eus/municipal/datos_estadisticos/vitoria_gasteiz.html.
Fahrradportal. 2019. *Fearless cycling - Subjective safety in bicycle traffic.* Accessed May 12, 2020. https://nationaler-radverkehrsplan.de/en/node/21473.
Fainstein, Susan S. 2019. "Urban Planning." *Encyclopædia Britannica.* Encyclopædia Britannica, inc. December 11. Accessed February 11, 2020. https://www.britannica.com/topic/urban-planning.
Field, Richard. n.d. *John Dewey (1859-1952).* Accessed May 21, 2020. https://www.iep.utm.edu/dewey/#H2.
Fiorello, Davide, Angelo Martino, Loredana Zani, Panayotis Christidis, and Elena Navajas-Cawood. 2016. "Mobility data across the EU 28 member states: results from an extensive CAWI survey." *Transportation Research Procedia* 14: 1104 - 1113.
Foletta, Nicole. 2014. "Case Study: Houten." *WPengine.* July 22. Accessed April 16, 2020. https://itdpdotorg.wpengine.com/wp-content/uploads/2014/07/22.-092211_ITDP_NED_Desktop_Houten.pdf.
Forgemind Archimedia. 2016. *Best laid plans: Masdar City's dreams of being the first net-zero city may have disappeared.* Accessed May 29, 2020. https://www.bdcnetwork.com/best-laid-plans-masdar-city%E2%80%99s-dreams-being-first-net-zero-city-may-have-disappeared.
Forum Vauban e.V., DLR, Oeko-Institut e.V. 2003. Final Report and evalution, Forum Vauban e.V., Freiburg: Forum Vauban e.V.
Fowler, David. 2019. *Fleet News.* September 18. Accessed April 22, 2020. https://fncdn.blob.core.windows.net/web/1/root/making-public-transport-free-or-accessible-to-all-david-fowler.pdf.
Freudendal-Pedersen, Malene. 2020. "Sustainable urban futures from transportation and planning tonetworked urban mobilities." *Transportation Research Part D: Transport and Environment* (Elsevier) 82: 11.
Freund, Peter, and George Martin. 2009. "The Social and Material Culture of Hyperautomobility: "Hyperauto."." *Bulletin of Science, Technology & Society* 29 (6): 476 - 482.
Gehl . 2020. *Gehl .* Accessed February 12, 2020. https://gehlpeople.com/story/.
Gehl. 2019. *Gehl.* Geopend February 12, 2020. https://gehlpeople.com/work/projects/.
Gehl, Jan, interview by Greg Lindsay. 2010. *Cities for People: A Q&A with Architect Jan Gehl* New York, (September 17). https://www.fastcompany.com/1689519/cities-people-qa-architect-jan-gehl.
—. 2011. *Life Between Buildings - Using Public Space.* Washington: Island Press.
Gehl, Jan, interview by Morten Munkholm. 2016. *Mennesket i centrum for byernes udvikling* (April 24).
Gehl, Jan. 2011. "Spaces for Walking, Places for Staying." In *Life between buildings - Using public space*, by Jan Gehl, 129 - 197. Washington DC: IslandPress.

Gehl, Jan, Lars Gemsøe, Sia Kirknæs, and Britt S Søndergaard. 2006. *New City Life*. 1 st ed. Copenhagen: The Danish Architectural Press.
Gemsøe, Lars. 2006. "Quality for people - A set of quality criteria for the design of pedestrian places and networks - with people in mind." *International Conference on Walking and Liveable Communities, Melbourne, Australia*. Accessed 05 22, 2020. http://plangate.no/mennesker/M%2006%20Gemzoe%20Quality%20for%20people.pdf.
Gent. 2019. *Stad Gent*. June 11. Accessed April 23, 2020. https://stad.gent/nl/mobiliteit-openbare-werken/nieuws-evenementen/evaluatie-circulatieplan-gentenaars-kiezen-vaker-voor-fiets-en-openbaar-vervoer.
GeoNames. 2015. *Population of Fès al Bali, Morocco*. December 28. Accessed March 04, 2020. https://population.mongabay.com/cities/morocco/fes-al-bali.html.
Global Site Plans. 2014. *Smart Cities Dive*. October 8. Accessed February 20, 2020. https://www.smartcitiesdive.com/ex/sustainablecitiescollective/pontevedra-spain-increases-downtown-livability-reducing-vehicle-access/999306/.
Goldsmith, Stephen. 2019. *Data-Smart City Solutions*. January 31. Accessed February 11, 2020. https://datasmart.ash.harvard.edu/news/article/designing-human-centered-city.
Government of India. n.d. "Liveability Standards in Cities." *SmartCities*. Accessed 05 22, 2020. http://smartcities.gov.in/upload/uploadfiles/files/LiveabilityStandards.pdf.
Guðmundsdóttir, Þóra Sif. 2019. *studentabladid*. March 12. Accessed February 21, 2020. http://studentabladid.com/efni/2019/3/12/the-car-free-city-of-pontevedra.
Habitat III. 2016. *Habitat III*. Geopend February 6, 2020. http://habitat3.org/the-conference/about-habitat-3.
Haha169. 2009. *Bestand:Location Map Asia.svg*. May 4. Accessed June 2, 2020. https://nl.wikipedia.org/wiki/Bestand:Location_Map_Asia.svg.
Hammersley, Martyn. 2004. "Literature Review." In *The SAGE Encyclopedia of Social Science Research Methods*, by Michael S Lewis-Beck, Alan Bryman and Tim Futing Liao, 578-579. Thousand Oaks: SAGE Publications Inc. Accessed 05 25, 2020. doi:http://dx.doi.org/10.4135/9781412950589.n503 .
Harmaajärvi, Irmeli, Sirkka Heinonen, and Pekka Lahti. 2004. "Abstract." In *Urban Form, Transportation and Greenhouse Gas Emissions: Experiences in the Nordic Countries*, by Irmeli Harmaajärvi, Sirkka Heinonen and Pekka Lahti, 89. TemaNord.
Haustein, Sonja, and Thomas Alexander Sick Nielsen. 2015. *Deleøkonomi i transport: udvikling, trends og potentiale*. DTU Transport. Accessed 05 28, 2020. https://backend.orbit.dtu.dk/ws/portalfiles/portal/116530932/notat_19_dele_konomi_MAJ_2015.pdf.
Herrman, Tyce, and Rebecca Lewis. 2017. *University of Oregon*. Accessed February 7, 2020. https://sci.uoregon.edu/sites/sci1.uoregon.edu/files/sub_1_-_what_is_livability_lit_review.pdf.
Hong, Andy. 2019. *Urban Transformations*. September 27. Accessed February 20, 2020. https://www.urbantransformations.ox.ac.uk/blog/2019/a-car-free-city-utopian-dream-or-realistic-vision/.
Horne, Ralph, and David Adamson. 2017. *The Conversation*. April 16. Accessed February 6, 2020. https://theconversation.com/what-can-the-new-urban-agenda-and-sustainable-development-goals-do-for-cities-75533.
Hunkin, Simon, and Katharina Krell. 2019. *Promoting Active Modes of Transport - A Policy Brief from the Policy Learning Platform on Low-carbon economy*. Interreg Europe (European Union - European Regional Development Fund).
Hunkin, Simon, and Katharina Krell. 2019. *Promoting Active Modes of Transport - A Policy Brief from the Policy Learning Platform on Low-carbon economy*. Policy Learning

Platform on Low-carbon economy, Interreg Europe (European Union - European Regional Development Fund).
ICLEI, A. 2017. "EcoMobility World Festival 2017 Report." *Kaohsiung EcoMobility World Festival 2017*. http://kaohsiung.ecomobilityfestival.org/download/ecomobility-world-festival-2017-report-final-pdf/?wpdmdl=7856&masterkey=5ad44a403bd3b .
ICLEI, B. 2017. "EcoMobility World Festival 2017: A summary of the first week." *Kaohsiung EcoMobility World Festival 2017*. http://kaohsiung.ecomobilityfestival.org/wp-content/uploads/2017/09/EMWF-8-day-report-20171010_Final.pdf.
ICLEI, C. 2017. "EcoMobility World Festival 2017: The Kaohsiung Strategies for the Future of Urban Mobility." *Kaohsiung EcoMobility World Festival 2017*. http://kaohsiung.ecomobilityfestival.org/declaration/.
IVA Mobiliteitsbedrijf and Transport & Mobility Leuven. 2019. *Stad Gent*. May. Accessed April 23, 2020. https://d21buns5ku92am.cloudfront.net/62000/documents/38207-Evaluatierapport%20Circulatieplan%20Gent%202019-26c1ca.pdf.
—. 2018. "Evaluatie Circulatieplan Gent." *Stad Gent*. March. Accessed April 23, 2020. https://stad.gent/sites/default/files/page/documents/Evaluatierapport%20Circulatieplan%20Gent.pdf.
Jeekel, Hans. 2014. "Social exclusion, vulnerable groups and driving forces: Towards a social research based policy on car mobility." *Case Studies on Transport Policy 2* (Elsevier) 96 - 106.
Kashef, Mohamad. 2016. "Urban livability across disciplinary and professional boundaries." *Frontiers of Architectural Research* (Higher Education Press) 5 (2): 239 - 252.
Kent, Jennifer L. 2014. "Driving to save time or saving time to drive? The enduring appeal of the private car." *Transportation Research Part A* (Elsevier) 65: 103 - 115.
Khomenko, Sasha, Mark Nieuwenhuijsen, Albert Ambrós, Sandra Wegener, and Natalie Mueller. 2020. "Is a liveable city a healthy city? Health impacts of urban and transport planning in Vienna, Austria." *Environmental Research*, Vol. 183 ed. Accessed 05 22, 2020. https://www.sciencedirect.com/science/article/abs/pii/S0013935120301304?via%3Dihub.
Ki-moon, Ban. 2014. *United Nations*. October 29. Accessed February 6, 2020. https://www.un.org/press/en/2014/sgsm16293.doc.htm.
Kotzeva, Mariana. 2016. *Urban Europe Statistics on cities, towns and Suburbs*. Statistical report, Eurostat, European Union, Luxembourgh: European Union, 286.
Kvale, Steinar. 2007. "Interview Variations." In *Doing Interviews*, by Steinar Kvale. London: SAGE Publications Ltd. doi:https://dx-doi-org.zorac.aub.aau.dk/10.4135/9781849208963.n6.
Kvale, Steinar. 2007. "Introduction to Interview Research." In *Doing Interviews*, by Steiner Kvale. London: SAGE Publications Ltd. doi:https://dx.doi.org/10.4135/9781849208963 .
Maix. 2007. *File:Blank map of Europe cropped.svg*. June 8. Accessed June 2, 2020. https://commons.wikimedia.org/wiki/File:Blank_map_of_Europe_cropped.svg.
Marans, Robert W. 2015. „Quality of urban life & environmental sustainability studies: Future linkage opportunities." *Habitat International* (Elsevier) 1 (45): 47 - 52.
Martine, George. 2007. *United Nations Population Fund*. Accessed February 6, 2020. https://www.unfpa.org/sites/default/files/pub-pdf/695_filename_sowp2007_eng.pdf.
Masdar City. n.d. "Masdar City Fact Sheet." *Masdar City*. Accessed 05 22, 2020. https://masdar.ae/-/media/corporate/downloads/media/masdar-city-fact-sheet.pdf.

Matterhorn Chalets. 2020. *Matterhorn Chalets.* Geopend 03 02, 2020. https://www.matterhornchalets.com/2017/10/10/electric-taxis-zermatt/.
McVean, Bruce. 2013. *Movement for Liveable London.* Cambridge University. February 24. Accessed February 18, 2020. https://movementforliveablelondon.com/2013/02/24/a-new-movement-for-the-new-city-bruce-mcveans-the-new-city-lecture/.
Mercer. 2019. *Vienna Tops Mercer's 21st Quality of Living Ranking.* Accessed 05 22, 2020. https://www.mercer.com/newsroom/2019-quality-of-living-survey.html.
Midtgaard, Sofus. 2016. *Leader Lab.* March. Accessed February 20, 2020. https://leaderlab.com/liveability-recomendation-copenhagen/.
Ministry of Foreign Affairs of Denmark. n.d. *A nation of cyclists.* Accessed 03 29, 2020. https://denmark.dk/people-and-culture/biking.
Modijefsky, Michiel. 2018. *Eltis.* September 19. Accessed April 21, 2020. https://www.eltis.org/discover/news/free-public-transport-launched-successfully-dunkirk.
Morgan, David L. 2014. "Pragmatism as a Paradigm for Mixed Methods Research." In *Integrating Qualitative and Quantitative Methods: A Pragmatic Approach*, by David L. Morgan, 25-44. SAGE Publications, Inc.
Mueller, Natalie, David Rojas-Rueda, Tom Cole-Hunter, Audrey de Nazelle, Evi Dons, Regine Gerike, Thomas Götschi, Luc Int Panis, Sonja Kahlmeier, and Mark Nieuwenhuijsen. 2015. "Health impact assessment of active transportation: A systematic review." *Preventive Medicine* (Elsevier) 76: 103 - 144.
Muhammad, Saim, Henk F. L. Ottens, Dick Ettema, and Tom de Jong. 2007. "Telecommuting and residential locational preferences: a case study of the Netherlands." *Journal of Housing and the Built Environment* 22: 339 - 358.
Muhs, Christopher D., and Kelly J. Clifton. 2016. "Do characteristics of walkable environments support bicycling? Toward a definition of bicycle-supported development." *Journal of Transport and Land Use*, 147-188.
Nations, United. 2015. *World Urbanization Prospects The 2014 Revision.* Department of Economic & Social Affairs, United Nations, New York: United Nations, 517.
Newman, Peter, and Jeffrey Kenworthy. 1999. "The Problem of Automobile Dependence at the End of the Twentieth Century." In *Sustainability and Cities: Overcoming Automobile Dependence*, by Peter Newman and Jeffrey Kenworthy, 27 - 67. Covelo: Washington DC: Island Press.
Nieuwenhuijsen, Mark J., and Haneen Khreis. 2016. "Car free cities: Pathway to healthy urban living." *Environment International* 94: 251 - 262.
Nieuwenhuijsen, Mark, Jeroen Bastiaansen, Stephanie Sersli, Owen Waygood, and Haneen Khreis. 2018. "Implementing Car-Free Cities: Rationale, Requirements, Barriers and Facilitators." In *Integrating Human Health into Urban and Transport Planning*, by Mark Nieuwenhuijsen and Haneen Khreis, 199 - 219.
Norn, Peter Andreas. 2018. *Creating liveable cities together.* Accessed 05 22, 2020. https://ramboll.com/ingenuity/creating-liveable-cities-together.
—. 2018. *Ramboll.* May 7. Accessed February 7, 2020. https://ramboll.com/ingenuity/creating-liveable-cities-together.
—. 2017. *What is a liveable city?* Accessed 05 22, 2020. https://ramboll.com/ingenuity/what-is-a-liveable-city .
Norn, Peter Andreas, Brian Landbo, Kirstine Vammen, Johan Winberg, and Sara Eichel-Illum. 2016. *Business Region Aarhus.* October 29. Accessed March 6, 2020. https://businessregionaarhus.dk/media/10173/analyse-af-business-region-aarhus-internationale-konkurrenceevne_2016.pdf.
Nussbaumer Knaflic, Cole. 2020. *LinkedIn.* Accessed May 27, 2020. https://www.linkedin.com/in/colenussbaumer/.

Nussbaumer Knaflic, Cole. 2015. "Storytelling with Data." In *Storytelling with Data: a data visualization guide for business professionals*, by Cole Nussbaumer Knaflic, 1 - 267. Hoboken, New Jersey: Wiley.

OECD. 2017. *OECD.* March. Accessed February 20, 2020. https://www.oecd.org/gender/data/how-do-partners-in-couple-families-share-paid-work.htm.

OECD/European Observatory on Health Systems and Policies. 2017. "Denmark: Country Health Profile 2017." *OECD.* Edited by Brussels European Observatory on Health Systems and Policies. OECD. Accessed May 21, 2020. https://www.oecd-ilibrary.org/docserver/9789264283343-en.pdf?expires=1590069548&id=id&accname=guest&checksum=2E47B7198DABBB33398FB2637E6F58B5.

—. 2019. "Denmark: Country Health Profile 2019." *OECD.* November 28. Accessed May 21, 2020. https://www.oecd-ilibrary.org/docserver/5eede1c6-en.pdf?expires=1590070094&id=id&accname=guest&checksum=A20AA7ABC4E6B6A08B6965A899964CB4.

Ohurtsov. 2015. *Girl Young Lifestyle Woman Female.* November 10. Accessed June 3, 2020. https://pixabay.com/photos/girl-young-lifestyle-woman-female-1026246/.

Orsman, Bernard. 2010. *New Zealand Herald.* July 5. Accessed February 12, 2020. https://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=10656528.

Oslo Kommune. 2019. *Bilfritt byliv 2019.* Oslo. https://www.oslo.kommune.no/getfile.php/13316788-1551871824/Tjenester%20og%20tilbud/Politikk%20og%20administrasjon/Slik%20bygger%20vi%20Oslo/Bilfritt%20byliv/Handlingsplan%20bilfritt%20byliv%202019.pdf.

Oslo Kommune. 2020. *Et steg mot framtidens bysentrum - Bilfritt byliv 2017-2019.* Oslo. https://www.oslo.kommune.no/getfile.php/13358711-1580458772/Tjenester%20og%20tilbud/Politikk%20og%20administrasjon/Slik%20bygger%20vi%20Oslo/Bilfritt%20byliv/Et%20steg%20mot%20framtidens%20bysentrum%2C%202017-2019.pdf .

Oslo, Municipality of. n.d. *Car free city life in Oslo.* https://www.oslo.kommune.no/politics-and-administration/green-oslo/best-practices/car-free-city/.

O'Sullivan, Feargus. 2020. *Is Vienna Really All That Livable? Depends on Where You Look.* Accessed 05 22, 2020. https://www.citylab.com/environment/2020/03/vienna-city-ranking-livability-environmental-justice-pollution/607432/.

Ouis, D. 2001. "Annoyance from road traffic noise: a review." *Journal of Environmental Psychology* 21: 101 - 120.

Pacione, Michael. 2001. "Urban liveability." In *Urban Geography a Global Perspective*, by Michael Pacione, 396 - 417. New York: Routledge.

Parapari, Danial Monsefi. 2010. „Automobile Dependency: Improving Urban Resilience through Urban Planning and Design." Thesis, Architecture and the Built Environment, KTH, Stockholm, 55.

Plattform autofrei/autoram wohnen. n.d. *Plattform autofrei/autoram wohnen.* Accessed 03 12, 2020. https://wohnbau-mobilitaet.ch/beispiele/siedlungen-europa/freiburg-im-breisgau-vauban/.

PopulationStat. 2019. *Barcelona, Spain Population.* September 5. Accessed June 2, 2020. https://populationstat.com/spain/barcelona.

Rambøll 1. 2018. *Creating Liveable Cities Together.* Survey, Copenhagen: Ramboll, 22. Accessed February 20, 2020. https://bedre-byer.ramboll.com/wp-content/uploads/2018/05/liveable_cities.pdf.

Rambøll 2. 2018. *Rambøll.* August. Accessed February 20, 2020. https://www.ramboll.com/-

/media/files/rgr/documents/markets/water/c/copenhagen-urban-lab-2018-13-august-2018.pdf?la=en.
Rambøll. 2010. *Rambøll.* April 9. Accessed February 20, 2020. https://ramboll.com/projects/rdk/nordhavn.
—. 2016. *Rambøll.* Accessed February 20, 2020. https://ramboll.com/media/articles/planning/creating-liveable-cities.
—. 2014. *Rambøll.* February 5. Accessed February 20, 2020. https://ramboll.com/megatrend/liveable-cities-lab.
—. 2015. *Rambøll.* Accessed February 20, 2020. https://ramboll.com/megatrend/liveable-cities-lab/projects.
—. 2017. *Rambøll.* November 7. Accessed February 20, 2020. https://ramboll.com/ingenuity/what-is-a-liveable-city.
Rasouli, Soora, and Harry Timmermans. 2014. "Effects of travel time delay on multi-faceted activity scheduling underspace-time constraints: A simulation study." *Travel Behaviour & Society* (Elsevier) 1 (1): 31-35.
Ritchie, Hannah, en Max Roser. 2019. *Our World In Data.* November. Geopend February 6, 2020. https://ourworldindata.org/urbanization.
Roberts, David. 2019. *Barcelona wants to build 500 superblocks. Here's what it learned from the first ones.* April 09. Accessed March 05, 2020. https://www.vox.com/energy-and-environment/2019/4/9/18273894/barcelona-urban-planning-superblocks-poblenou.
—. 2019. *Barcelona's remarkable history of rebirth and transformation.* April 8. Accessed May 5, 2020. https://www.vox.com/energy-and-environment/2019/4/8/18266760/barcelona-spain-urban-planning-history.
Rozek, Julianna, Billie Giles-Corti, and Lucy Gunn. 2018. *The world's most liveable city isn't a measure of the things most of us actually care about.* Accessed 05 22, 2020. https://theconversation.com/the-worlds-most-liveable-city-title-isnt-a-measure-of-the-things-most-of-us-actually-care-about-101525.
Ruth, Matthias, and Rachel S. Franklin. 2014. "Livability for all? Conceptual limits and practical implications." *Applied Geography* (Elsevier) 49: 18 - 23.
Schwanen, Tim. 2013. *Rethinking behaviour change with Dewey.* April 28. Accessed May 23, 2020. http://www.timschwanen.com/archives/tag/habit.
—. 2012. *Rethinking habits of everyday mobility.* July 10. Accessed Mai 23, 2020. http://www.timschwanen.com/archives/tag/habit.
Schwanen, Tim, and Karen Lucas. 2011. "Understanding Auto Motives." In *Auto Motives: Understanding Car Use Behaviours*, by Karen Lucas, Evelyn Blumenberg and Rachel Weinberger, 3 - 38. Bingley: Emerald Group Publishing Limited.
Schwanen, Tim, David Banister, and Jillian Anable. 2012. "Rethinking habits and their role in behaviour change: the case of low-carbon mobility." *Journal of Transport Geography*, September: 522-532.
Smart Aarhus. 2015. *Smart Aarhus.* Accessed February 18, 2020. https://www.smartaarhus.eu/projects/smart-city-network.
Smart Cities World. 2019. *Smart Cities World.* February 13. Accessed February 20, 2020. https://www.smartcitiesworld.net/governance/copenhagen-and-bern-named-most-liveable-cities-3852.
Stad Gent. 2016. "Mobiliteitsbedrijf Stad Gent." *Stad Gent.* October 24. Accessed April 23, 2020. https://stad.gent/sites/default/files/page/documents/20161024_CirculatieplanBinnenstadGent.pdf.
Stadt Freiburg im Breisgau. 2014. *Quartier Vauban Von der Kaserne zum stadtteil - Abschlussbericht zur Entwicklungsmaßnahme Vauban | 1992 - 2014.* Final Report

and evaluation, Freiburg: Stadt Freiburg im Breisgau - Amt für Projektentwicklung und Stadterneuerung.
Stadt Freiburg. 2012. *Verkehrskonzept*. November 16. Accessed April 21, 2020. https://www.freiburg.de/pb/208744.html.
Statistics Denmark. 2020. "Cars." *BIL10: Stock om passenger cars per 1 January by propellant and tare*. Statistics Denmark, 03 20.
—. 2020. "Cars." *BIL51: New registrations of passenger cars by ownership, propellant and time*. 03 17.
—. 2019. "Passenger transport." *PKM1: Passenger transport performance by transport unit* . 11 5.
—. 2020. *Statistics Denmark*. Accessed May 21, 2020. https://www.dst.dk/en/Statistik/emner/befolkning-og-valg/befolkning-og-befolkningsfremskrivning/folketal.
Statistics Norway. 2020. *Oslo*. Accessed June 2, 2020. https://www.citypopulation.de/en/norway/admin/oslo/0301__oslo/.
Stougaard, Lasse Emil. 2016. *A Tangible Understanding of Liveability*. Master thesis, Urban Planning & Management, Aalborg University, Aalborg: Aalborg University, 75.
Sturgis, Sam. 2015. *CityLab*. April 7. Accessed February 19, 2020. https://www.citylab.com/transportation/2015/04/how-suburban-cars-are-clouding-up-cities/389832/.
Sumantran, Venkat, Charles Fine, and David Gonsalvez. 2017. *The Guardian*. October 16. Accessed February 19, 2020. https://www.theguardian.com/environment/2017/oct/16/our-cities-need-fewer-cars-not-cleaner-cars-electric-green-transport.
The Economist Intelligence Unit. 2019. "The Global Liveability Index." *The Economist Intelligence Unit*. Accessed 05 22, 2020. http://www.eiu.com/Handlers/WhitepaperHandler.ashx?fi=Liveability-Free-report-2019.pdf&mode=wp&campaignid=liveability2019.
Thomas, Gary. 2011. "A Topology for the Case Study in Social Science Following a Review of Definition, Discourse and Structure." *Qualitative Inquiry*, 511-521. Accessed 05 25, 2020. doi:10.1177/1077800411409884.
Turcotte, Martin. 2011. *Commuting to work: Results of the 2010 General Social Survey*. Statistics, Statistics Canada, 25 - 36.
U4SSC. 2017. *U4SSC*. Geopend February 7, 2020. https://www.unece.org/fileadmin/DAM/hlm/documents/Publications/U4SSC_Brochure_Implementing_sustainable_development_goal_11.pdf.
United Nations. 2017. *Habitat III*. Accessed February 7, 2020. http://habitat3.org/wp-content/uploads/NUA-English.pdf.
United Nations Department of Economic and Social Affairs. 2018. *The world's cities in 2018*. Department of Economic & Social Affairs, United Nations, 34.
United Nations. 2017. "New Urban Agenda." *Habitat III*. Accessed May 29, 2020. http://habitat3.org/wp-content/uploads/NUA-English.pdf.
United Nations SDG. 2018. *Sustainable Development Agenda*. June 20. Accessed February 6, 2020. https://www.un.org/sustainabledevelopment/development-agenda-retired/.
United Nations. 2015. *Sustainable Development Goals*. Accessed February 6, 2020. https://www.un.org/sustainabledevelopment/summit/.
—. 2015. "Transforming our world: the 2030 agenda for sustainable development." *Sustainable development*. October 15. Accessed May 29, 2020. https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf .

—. 2018. *United Nations.* May 16. Accessed February 6, 2020. https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html.
Unlocking Sustainable Cities. 2018. *Unlocking Sustainable Cities.* September 19. Accessed February 21, 2020. http://unlockingsustainablecities.org/car-free-manifesto.html.
Valencia, Sandra, David Simon, Sylvia Croese, Joakim Nordqvist, Michael Oloko, Tarun Sharma, Nick Taylor Buck, and Ileana Versace. 2019. "Adapting the Sustainable Development Goals and the New Urban Agenda to the city level: Initial reflections from a comparative research project." *International Journal of Urban Sustainable Development* (Informa UK Limited) 11: 4-23.
van Dorst, Machiel. 2012. "Liveability." In *Sustainable Urban Environments: An Ecosystems Approach*, by Ellen van Bueren, Hein van Bohemen, Laure Itard and Henk Visscher, 413. Delft: Springer Science; Business Media B.V.
Velasquez, Jaime. 2018. *City Lab.* November 26. Accessed February 21, 2020. https://www.citylab.com/design/2018/11/car-free-pedestrianization-made-pontevedra-spain-kid-friendly/576268/.
Way, Catharine. 2015. "The Millennium Development Goals Report." *United Nations.* July 6. Accessed May 28, 2020. https://www.un.org/millenniumgoals/2015_MDG_Report/pdf/MDG%202015%20rev%20(July%201).pdf.
WHO. n.d. *Noncommunicable diseases.* Accessed 04 13, 2020. https://www.who.int/health-topics/noncommunicable-diseases#tab=tab_1.
—. 2018. *Physical activity.* Accessed 04 13, 2020. https://www.who.int/news-room/fact-sheets/detail/physical-activity.
Willsher, Kim. 2018. *The Guardian.* October 15. Accessed April 22, 2020. https://www.theguardian.com/cities/2018/oct/15/i-leave-the-car-at-home-how-free-buses-are-revolutionising-one-french-city.
Woldeamanuel, Mintesnot G. 2016. "History of Urban Transportation." In *Concepts in Urban Transportation Planning: The Quest for Mobility, Sustainability and Quality of Life*, by Mintesnot G. Woldeamanuel, 288. McFarland.
World Health Organization. 2017. *Air Pollution.* November 6. Accessed May 29, 2020. https://www.who.int/health-topics/air-pollution#tab=tab_1.
Worley, Will. 2016. *Independent.* September 14. Accessed February 20, 2020. https://www.independent.co.uk/news/world/europe/copenhagen-most-liveable-city-best-places-to-live-list-rankings-a7296096.html.
Zermatt Tourism. 2020. *Zermatt Matterhorn.* Geopend 03 02, 2020. https://www.zermatt.ch/en/arrival/Autofrei-GEX-MTT/Zermatt-is-car-free.