Peak Car[1] and the Future of Urban Mobility.

Exploring 21st century urban trends and their implications for the automotive industry.

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Master of Science in Urban Planning

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[1] Peak car is a term that is drawn from an analogy with peak oil expressing the succinctly hypothesis that the usage of the personal automobile has peaked and summarizes the debate about whether the long dominant growth car use specifically has come to an end or if it is only temporarily interrupted (International Transportation Forum, 2012).

ABSTRACT

For many decades, car manufacturers, urban planners and large parts of society saw the automobile as an integral part of modern life and it was the preferred mobility option for many people. It symbolized freedom, independence and liberation and has frequently been seen as a status symbol. Motorized vehicle travel has grown steadily over the past century but now has started to peak in most developed countries. Demographic changes and an ageing society, the rise of information and communication technologies, changing urban spatial patterns and increased urbanization, changing consumer preferences and fundamental shifts in urban social lifestyles are reducing demand for automobile travel. The question for the automotive industry therefore increasingly becomes one of defining its future role in the 21st century urban transportation.

This thesis aimed to explore current urban trends influencing our urban transportation systems. While current mobility issues were briefly looked at, the focus was on understanding urban trends influencing passenger transportation in developed countries. Recent answers and growth strategies of the car industry were mirrored against those trends to find potential shortcomings and mismatches. The research revealed that there is a certain disconnect between the urban trends and how car manufacturers are seeing and responding to the trends. Most of the urban trends described in this thesis were taken into consideration by the car manufacturers in some way. However, in most cases there has been a focus on a technological fix of the challenges and though there are certainly many synergies and advantages to explore through the employment of new technologies, it is most likely not the only answer. The car manufacturers seem to be whistling past the grave yard and are stuck in their need to defend the technologies they have invested in so much.

The thesis concludes with implications for the automotive industry as well as urban planners and policy makers and how they can respond to these changing urban trends. The author encourages a more multi-modal approach for our future urban transportation systems as well as more cooperative out-of-the-box thinking by both – private and public sectors.

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1. INTRODUCTION

For many decades, car manufacturers, urban planners and large parts of society saw the automobile as an integral part of modern life and it was the preferred mobility option for many people. It symbolized freedom, independence and liberation and has frequently been seen as a status symbol (Singer, 2013).

Over the past decades, however, an increasing amount of mobility challenges evolved ranging from discussions around climate change, scarcity of resources, safety issues, traffic congestion, social equity and access to mobility resulting in increased competition and market pressure for the automotive industry (Althaus, 2012; Banister, 2011; UN Habitat, 2013; Cortright, 2014). The car industry always responded to those new challenges in a similar way: With new technological innovations. Urban transportation for many years has therefore been a primarily technologically determined service with the automotive industry providing new technological solutions to, according to them, solely technical problems of our urban mobility environment.

New waves of innovation, mostly led by the car manufacturing and tech companies, are now trying to transform the product and driving experience. The impact of contemporary information technologies started to become manifest in the context of urban travel only recently and we might be facing a paradigm change in personal transportation of the use of real time information to make travel and activity decisions (Sclar, 2014). Thanks to on-board computers and new technologies, vehicles are becoming smarter, safer, and more fun. Listening to the marketing campaigns of the automotive industry and tech companies like Google, autonomous driving and the self-driving car seem to be "just around the corner" promising an even safer, smarter and more exciting driving experience for its customers.

However, on the other hand, many urban trends are influencing the travel behavior of the developed world and current research actually shows stagnating or even declining usage of the automobile. The rise of information and communication technologies accelerated increased telecommuting, online shopping and the use of social media which influence today's travel behavior in a way that people abstain from taking trips they would have previously realized by car, e.g. grocery shopping (Banister and Stead, 2004; Kotkin, 2008). The car, which used to be a status symbol and stood for freedom and independence, now seems to have a different meaning to younger generations (Litman, 2014; Davis et al., 2012; Zax, 2014; Goodyear, 2014; Goodwin, 2012)

First results of these trends are already visible: Not only do people in developed countries own fewer cars, but they're also driving each of them less. This downward trend seems to be driven not only by the rise of telecommuting and new technologies, urbanization and an increased public transit usage, but also by fundamental shifts in demographics and urban social lifestyle. Is this evidence of peak car use?

The question for the automotive industry therefore increasingly becomes one of defining its future role in the 21st century urban transportation.

2. RESEARCH QUESTION & HYPOTHESIS

2.1. COURSE OF RESEARCH

This thesis aims to explore current urban trends influencing the future of urban transportation systems. While current mobility issues will be briefly looked at, the focus will be on understanding urban trends influencing passenger transportation in developed countries. In a next step, recent responses and growth strategies of the car industry to our urban transportation challenges will be mirrored against those trends and the potential role of car manufacturers in the 21st century will be explored.
The historical context of the automobile and its meaning for society will establish the background for this thesis. A literature review will follow, briefly summarizing current urban mobility challenges, including climate change, safety concerns, traffic congestion, social equity and access, to then thoroughly explore urban trends and their implications, including the rise of ICT, changes in demographics, population growth and urbanization, lifestyle changes and city development.
The goal is to establish a clear understanding of the following research questions:

- What role did the car play in the history of the Western world?
- How did different stakeholders see mobility over time?
- What are the current issues of urban personal transportation?
- What are the current urban trends in developed countries and how are those trends influencing urban transportation?
- What do the statistics say about automobile travel behavior in developed countries?

Even though this research is targeted on examining passenger cars and a geographical scope of Europe, North America and Japan, it will inevitably also reveal information about other modes of urban transportation, as well as other regions.
In a second step, original research will be conducted through an extensive data analysis as well as surveying representatives of the automobile industry and experts in the field with the intention to find out how they are reading current urban trends, how they are reacting to them and, potentially, what their future strategies look like.
Important questions to answer in this step will be:

- What do car manufacturers see as the most critical and challenging urban trends? And why do they see them in the way they do?
- How are car companies reacting to those changing urban patterns?
- How do growth strategies in the car industry look like?

- What different types of mobility initiatives have been undertaken and what new mobility products have evolved to meet changing urban mobility trends?
- Which of the discussed urban trends are explicitly being addressed and which ones are left out in current car manufacturers communications?

Following the exploration of urban trends and the evaluation of data analyses and survey results from the questionnaires and expert interviews, those results will be discussed and contrasted. The goal is to find differences between what data and secondary research say about current urban trends and how automotive companies are responding to those trends within their future growth strategies.
The following questions will be addressed:

- Are urban trends integrated in future strategies of the automotive companies?
- How do different car manufacturers respond to urban trends and challenges?
- What are the limitations of current strategies followed by car manufacturers?
- What can be new approaches for car manufacturers to play a vital role in the 21st century urban transportation system and how can their role as mobility providers be re-defined?

The results of this research will be of primary importance to urban planners as well as the automotive industry. For urban planners and transportation engineers, it will reveal crucial information on how one major actor, the automotive industry, is reacting to urban trends influencing the future of mobility. The question of how we will shape our cities in the future highly depends on those developments.
For the automotive industry, the results of this thesis are important factors to include in R&D, product planning and future corporate strategies. A potential disconnect between the urban trends discussed in this thesis and a car manufacturer's future strategy could initiate a re-evaluation of the current path.

2.2. METHODOLOGY

This thesis includes primary and secondary research data. An extensive literature review and a brief evaluation of statistics related to the changing urban transportation system form the framework of this thesis and include a brief historical background of the automobile, current mobility challenges and urban trends. While current mobility challenges, like climate change, traffic congestion, safety concerns etc., play an important role in present mobility discussions, they are not the primary research subject of this thesis and are only briefly discussed. Following, several urban trends influencing the urban mobility system that have been chosen by the author are presented and discussed.

Original research was conducted through data analyzes and surveys. The data analysis focuses on annual reports of several major car manufacturers on the one hand, and their marketing materials and external communications on the other hand.
A matrix was developed and used as a framework for the analysis of annual reports of the years 2005 and 2013 of ten major car manufacturers showing their growth strategies and mirroring the previously discussed urban trends. Analyzing their most current available annual reports of 2013 (published in 2014), as well as contrasting them to the reports from about a decade ago, will show if their strategies have changed over time and if urban trends that were taken into consideration over the years are different ones.
To complement the rather past-directed analysis of annual reports, current marketing materials and external communications indicating the companies' future directions of urban mobility were reviewed and analyzed.
Further, a survey was conducted in the form of questionnaires that were distributed via email to key strategists in the automobile industry and experts of the field with the goal to get an internal perspective on the car manufacturers responses to current urban trends as well as insights into how experts are reading those trends. This research had the geographical focus of the United States, Europe and Japan.

2.3. LIMITATIONS

There are several limitations to the research results of this thesis due to the method of research. The data analysis was mainly focused on annual reports and official external communications of the automotive industry with the goal to compare and evaluate different car manufacturer strategies and to see whether or not urban trends were incorporated in their strategies. However, since annual reports primarily report on past achievements of the enterprise and usually show future strategies to only a limited extend, the evaluation might not reflect the companies' real long-term strategies, which are mostly highly confidential. To counter the fact of annual reports being mainly past-oriented, current marketing materials and external communications were reviewed. However, even the analysis of future-oriented marketing materials has limitations, as those strategies are predominantly market-driven and companies might try to test out certain innovations and future strategies before actually following them.
Further, not mentioning certain trends and strategic plans is a lot of times simply due to maintaining or gaining a competitive advantage over competitors.
Similar limitations apply to the significance of the survey results. Being asked these questions as corporate representatives and as sources in their official capacities, surveyed subjects might not be willing or allowed to speak openly about corporate

strategies, or the answers might much more reflect their own views. Further, as a matter of fact, even expert opinions can vary greatly in their results, as their opinions are subjective and shaped by their individual background.

3. BACKGROUND AND LITERATURE REVIEW

3.1. HISTORICAL CONTEXT OF THE AUTOMOBILE

Throughout history, transportation has been a major factor in determining the manner in which society has developed. Mobility and interaction with others can be understood as basic needs of the human race and, transportation, therefore, has represented one of the most dynamic forces in shaping cities (Seifert, 1968).
After Henry Ford's introduction of his Model T in 1908 and with the start of its mass production in 1913, motor traffic in American cities started to build up. By the end of WWI, the automobile quickly transitioned from a luxury good and rich novelty to a common necessity for commuting, shopping and socializing (Hanson and Giuliano, 2004). In response to the opportunities the car offered to people, the 1920s and 1930s were characterized by new highway concepts which culminated in the New York World's Fair of 1939 where General Motors provided a vision of uninterrupted travel and an automated highway system to show what roadways and transportation might look like in 20 years (Fisher, 2010). Central to their Futurama exhibit was the indisputable dominance of the automobile.
After the Second World War, freeways started to extend to serve suburbs and other growing areas and the automobile was fully integrated in people's daily lives. To the post-war generation, cars stood for freedom and prosperity and the car represented for many families a status symbol and a 'ticket to the good life' in the suburbs, away from the crowded and increasingly dangerous cities (Singer, 2013). Getting a driver's license was a 'rite of passage' for young people, and something that was ideally done as soon as someone turned 16 (Davis et al., 2012). America engaged in the greatest road and highway building project that the world had ever seen up until this point and constructed more than 40,000 miles of Interstate highways (Davis et al., 2012). This maturing freeway system was one of the primary forces that turned the metropolis inside-out after 1970, and caused a landscape of suburban sprawl (Hanson and Giuliano, 2004).
In the years that followed, high rates of car ownership have been favored by heavy investments in road infrastructure, sprawling urban forms and increased per capita incomes (UN Habitat, 2013). Cities in the developed world grew in car use per capita by 42% in the 1960s, by 26% in the 1970s, and by 23% in the 1980s (Newman and Kenworthy, 1999). Cars became cheaper, faster, safer and more comfortable than ever before.

3.2. CURRENT MOBILITY CHALLENGES

In the last quarter of the 20th century, what once represented freedom and prosperity has become for many people a financial burden, a symbol of the nation's enduring dependence on oil (Davis et al., 2012) and a topic of continuing discontent – especially regarding urban personal transportation.

Global motorization has led to increased energy use and is one of the major contributors to greenhouse gas emissions, the major cause for climate change. The transport sector is responsible for almost 60% of the oil consumption or almost 30% of the total energy consumption in OECD countries (Althaus, 2012). Since motorized urban transport relies to almost 95% on oil-based products for its energy supply, individual mobility can be seen as one of the most relevant and fastest growing contributors to climate change. On a global level, the CO2 emissions from the transport sector have increased by 85% from 1973 to 2007 (UN Habitat, 2013).

U.S. cities exhibit the most extreme dependence on the automobile of the developed countries (Kenworthy and Laube, 1999). In 2006, the US produced 21% of the carbon emissions from energy, including transportation (Banister, 2011). In an attempt to raise fuel economy and lower emissions, environmentalists and car manufacturers advocated for hybrid and alternative fuel vehicles, e.g. through powering cars with biofuels like ethanol. Unfortunately, studies show that ethanol can produce as much or more greenhouse gas and pollution than burning conventional fossil fuels, considering the inputs and energy needed to grow, process and transport the fuels (Singer, 2013). Banister (2011) argues that technology has not kept pace with the growth of car-based travel, and that even a substantial shift to more efficient vehicles and alternative fuels would not be able to address the problem of transportation-related climate change. According to him, significant reductions of CO2 emissions in transportation can only be achieved through behavioral change and a considerable paradigm shift.

Another transportation issue is safety. Road traffic accidents are the ninth leading cause of deaths worldwide, accounting for 2.2% of all deaths (UN Habitat, 2013). According to the International Transport Forum's Annual Report (2014), fatalities from road incidents have been following a long-term downward trend. However, the year 2012 saw the smallest reduction in ten years, especially regarding saving lives among vulnerable road users like pedestrians, cyclists and motorcyclists. Further, so the report states, the costs of road crashes are substantial and constitute a major burden for economies. Although there is no international approach to assessing crash costs, estimates range from 1-3% of a country's GDP (International Transport Forum, 2014).

The concentration of an ever-increasing fraction of people in urban areas and the ever-increasing reliance on the private automobile as the principle mode of transportation ultimately led to the problem of traffic congestion (Seifert, 1968).

Traffic congestion is for many just an undesirable by-product of increased urban mobility and a major factor restricting access in cities (UN Habitat, 2013). Not only has it resulted in increased air pollution in congested areas, but also time delays, upset drivers and, according to various sources, costs $124 billion a year and is draining the U.S. economy. Other sources, however, state that congestion is not quantifiable in monetary terms (Cortright, 2014).

Still, the rate of increase of supply of new infrastructure in attempts to relieve traffic congestion, will never match growth in demand (Banister, 2011). Besides, there is little space left for expansion, since the existing streets and automobile accessible surfaces already consume cities and urban centers.

Buehler and Pucher (2012) conducted a study comparing demand for public transportation and rider characteristics between Germany and the U.S. and found that Germans are five times as likely to use public transport than Americans. Public transport use dropped in the US after the Second World War from 16.4 billion trips in 1945 to 4.7 billion in 1973. As one of the most important differences between the countries, Buehler and Pucher state that the local, state and federal governments in the U.S. have failed to restrict car use in cities, raise the cost of driving and improve land-use priorities. At all levels of government, roadways, car use and parking were prioritized and subsidized.

Another discussion is about accessibility versus mobility. Even though urban mobility systems aim to provide access to basic goods, services and activities to enable people to participate in civic life, in reality, people do not have equal access to urban opportunities and unaffordability and this is a major factor of social exclusion (UN Habitat, 2013). Many of these problems are intensified in developing countries, where mobility and accessibility are rapidly declining and accessibility and social equity questions play an important role when it comes to urban transportation. Most developing countries can't keep up with the rapid pace of motorization and the conditions of local demand far exceed the capacity of facilities. Their infrastructure is still largely incompatible with the increased motorization, not only due to a lack of road maintenance (Gakenheimer, 1999).

4. URBAN TREND ANALYSIS

This section aims at exploring recent urban trends that influence the urban transportation system and people's travel behavior. All of those trends will be discussed beyond the background of what it could mean for the future of urban transportation, especially the automobile.

4.1. CHANGES IN TRAVELING PATTERNS

Motorized travel grew tremendously during the 20th century and for a long time, no saturation of traffic volume was evident, rather it was predicted to rise. *Travel demand* refers to the amount and type of travel people would consume in a particular situation, considering factors such as the quality and price of available transport options (Litman, 2013). In 1960, world inhabitants traveled an average of 1820 km by car, bus, railway, or aircraft. Three decades later, in 1990, the annual distance traveled has increased to 4390 km (Schafer, 1998). The population with highest per capita incomes, the OECD regions, traveled the most. According to Schafer and Victor (2000), today's world citizens move 23 billion kilometers in total and are projected to increase travel to 105 billion kilometers by 2050.

However, in many advanced economies, automobile use per capita and total car traffic have recently shown low growth rates and in some countries, especially in cities, have declined in absolute terms (Goodwin, 2012). The notion of 'peak car' or 'peak travel' is used by many researchers to suggest that we are currently witnessing the end of building cities around cars – at least in the developed world (Newman and Kenworthy, 2012; Millard-Ball and Schipper, 2010; Goodwin, 2012). According to studies by Millard-Ball and Schipper (2010), motorized travel demand by all modes has leveled out or even declined in most developed countries since 2003 and travel in private vehicles has declined.

While car ownership has continued to rise but at a slow rate and recently even started to level off, these cars are being driven less. The period of vehicle ownership growth coincided with Baby Boomer's peak driving years, significant growth in female employment rates, rising wages, low fuel prices, cheap credits and suburbanization – trends which now seem to have peaked and are even reversing (Litman, 2013).

Total passenger kilometers of motorized travel has slowed its growth relative to GDP and even declined in per capita terms in some countries (Millard-Ball and Schipper, 2010). The rich world seems to show a saturating trend of vehicle-miles traveled and the factors that have been reason for the tremendous growth in motorized mobility during the 20th century are unlikely to continue (Litman, 2006).

Further, there have been significant changes in the character of personal travel and trip purpose during the past century. While most people worked, shopped and socialized close to their home at the beginning of the 20th century, people increasingly organized their lives around growing mobility options as travel costs declined and households dispersed. However, virtually all types of trips have peaked, and both commuting and household errand trips declined (Litman, 2013).

Goodwin (2012) names several factors to explain the widespread reduced growth in car use, among which are traditional economic factors of price and income like rising fuel prices and costs of cars, but also changes in the relative quality and reliability of car travel, like increased traffic congestion, increased provision of cycle lanes in cities

and improvements in public transportation. Other reasons, some of which will be described in more detail in the following, are an increased re-investment in transit infrastructure, influence of ICT, growth of a culture of urbanism, ageing of cities, reversal of urban sprawl, limited travel time budgets and fundamental generational shifts taking place (Litman, 2006; Litman, 2013; Badger, 2013; Millard-Ball and Schipper, 2010; Newman and Kenworthy, 2011, The Economist, 2012).
Interestingly, this trend of reduced car use is not only visible in the US, but also all over Europe. As cited in a recent article in The Economist (2012), the share of young households without cars in Germany increased from 20% to 28% between 1998 and 2008 and, in the U.K., total traffic has not increased for a decade, despite population growth.

4.2. DEMOGRAPHIC CHANGES

Since 2000, the senior population has increased 29% to an overall population growth of 12%. The percentage of Americans in the senior population has increased from 12.4% to 14.1%, and their share of the population is projected to climb to 19.3% by 2030 (Kotkin and Cox, 2014). Those disruptive demographics are likely to dramatically change during the next 25 years as more baby boomers reach their 60s, 70s and beyond (Bailey, 2004) will affect the future of our transportation system. Today's transportation system was designed to support the 9-to-5 work schedule from a within-city or suburb-to-city location. Tomorrow's traveler, however, is likely to be older and, according to Coughlin and Tompkins (2009), female, racially and ethically diverse, and working flexible hours 24/7 across sprawling regions.
Supporting their argument of 'peak car', Newman and Kenworthy (2011) argue that the average age of people living in cities has been getting older and that since people who are getting older tend to drive less, cities therefore are likely to show less car use (also: Shergold, 2010; Litman, 2006; Bailey, 2004). A study by Bailey (2004) found that one in five (21%) Americans age 65 and older do not drive due to declining health and eyesight, concerns over safety, no car or no access to a car, or out of personal preference.
Goodwin (2012) further argues that there will be considerable changes in the demographics and lifestyles in cities and suburbs due to the longevity of particular life-cycle changes and the locations where people prefer to spend them, i.e. young couple shifts from inner cities to suburbs and then return to the cities when their children leave the home.

4.3. INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT)

The late 20th century was characterized by a transition from an industrial mode of production to an information mode in which space has become increasingly irrelevant and technological innovation is fundamentally influencing the function and form of cities (Banister and Stead, 2004). During the 20th century, technological innovations significantly improved motor vehicle performance in terms of speed, safety, reliability and comfort which increased vehicle travel (Litman, 2013).

Since urban transportation is basically a technologically determined service and throughout history the city was shaped by technological innovations (i.e. rail and the automobile) the emergence of an extended network of information and communication technologies is having an enormous impact on the spatial relations of a city and mobility in all forms. We are now facing a paradigm change in personal transportation due to the use of real time information to make travel and activity decisions (Sclar et al., 2014).

Banister and Stead (2004) have come up with three basic arguments to categorize the possible impacts of ICT on transport:

1) Stimulation of more travel as new opportunities become available;
2) Substitution of travel as activities can now be carried out remotely rather than by travel;
3) Modification of travel as the two elements combine to change the ways in which activities are carried out.

Many scholars also name the increased use of ICT in our daily lives as one of the major reasons for a stagnating or decreasing usage of the personal automobile (Kotkin, 2008; Badger, 2013; Sclar et al., 2014; Goodwin, 2012; Martin and Shaheen, 2011; Hanson and Giuliano, 2004; Davis et al. 2012, Banister and Stead, 2004).

Global markets and the nature of our work have changed significantly in recent years due to the rise of ICT. ICT has made it possible to carry out transactions automatically and in real time and, consequently, reduced the need to travel for many transactions. Various forms of e-commerce and e-information (online shopping, virtual conferences and meetings, telecommuting, online newspapers) decreased the need for the movement of goods in many cases as orders can be transmitted electronically, emails sent instead of letters, meetings held online and services or goods like music downloaded electronically from the web or groceries and other items purchased on Amazon (Banister and Stead, 2004). Also, for over a decade, the number of telecommuters has been growing rapidly, gaining more market share than any other form of transportation due to, i.e. the proliferation of broad-band technology, the effect of high gas prices and the new flexibility to create customized work schedules (Kotkin, 2008). The increase of e-commerce, however, not only results in a decreased level of personal trips, but more space available on the streets. Much more, those trends of ever increasing online-shopping and the implied truck deliveries and mail

services pose a new challenge to the urban transportation system – traffic congestion due to delivery trucks parked on streets all over the city. Curb space in cities is becoming more and more scarce.

The introduction and rapid rise of the Internet and smartphones as a major cultural shift in how users see and achieve their daily activities (Sclar et al., 2013). Particularly for young people, communication technologies in forms of new social networking and recreational possibilities has become a substitute for many car trips. Social media give them access to the world that once has been associated with cars and liberalization through the automobile. A study found that in America an overwhelming number of 18- to 34-year-olds say that socializing online is a substitute for some car trips (The Economist, 2012). Further, improvements in technology make transportation alternatives more convenient and technology seems to have opened the door for new transportation alternatives, such as bike-sharing, car-sharing and multimodal transportation options. Websites and smartphone apps provide real-time transit data making public transportation significantly easier to use (Davis et al, 2012). Martin and Shaheen (2011) conducted a study on the impact of car-sharing on household vehicle ownership and concluded that car-sharing lowers the total number of vehicles owned by members. According to them, car-sharing services which give access to its members to an automobile for short-term use, have grown to more than 20 major metropolitan regions throughout the U.S. and Canada. By 2011 they served almost 604,000 members with about 10,000 vehicles and the trend is only expected to continue.

Litman (2013) summarized the impact of new transportation technologies as follows: Increased fuel efficiency and cheaper alternative fuels, increased vehicle comfort and automated driving are likely to increase motorized travel. Electronic vehicle navigation and improved traffic signal control might lead to mixed mobility impacts as driving comfort is increasing, but travel efficiency as well. Improved road and parking pricing, transit and car sharing service improvements, improved user information, improved delivery services as well as electronic communication that substitutes for physical travel are likely to reduced motorized travel and support the notion of peak car (Litman, 2013).

4.4. URBANIZATION AND CITY DEVELOPMENT

Current population projections state that by 2050 over 70% of the world's population will be living in urban areas. The world is becoming more urbanized and urban living will be at the center of most activity as more and more people are expected to move back to cities (Banister, 2011; Boarnet, 2013). This trend is predicted to be even more visible in OECD countries, expecting 86% of the developed world's population to live in urban areas by 2050, up from 77% in 2010 (The Economist, 2013).

Urbanism will not only exert major influence and profound changes in every phase of social life (Wirth, 1938), but also their mobility patterns. The quality of urban access, then, will be determined by how well cities are able to co-locate diverse activities in close proximity to one another and through the ways their urban transportation systems bring people together and allow them to interact (Sclar et al., 2014). Suburbs are likely to merge with the urban peripheries creating huge metropolitan areas. As suburbs grow and congestion increases, cities will eventually hit so-called “sprawl walls” or “Marchetti Wall” which refer to the available time budgets of commuters (Newman and Kenworthy, 2011; The Economist, 2013; Goodwin, 2012). As commutes get too long or too inconvenient due to increased traffic congestion, people are likely to switch transportation modes away from the personal automobile to relatively faster and more convenient options, like transit.

The paradigm of city planning has for many years promoted the compact city of dense development focused around centers of employment and local services to reduce the need for long commutes and make cities more vibrant (Echenique et al., 2012). This trend of turning back to cities is finally visible, as data on density suggests that the peak in declining densities has occurred and that cities are now coming back in faster than they are going out. A study by Newman and Kenworthy (2012) depicts data from various cities in Australia, Canada, Europe and the US that clearly demonstrates this turning point of cities towards increased urbanization. Developments in land use-planning show an increased rate of redevelopment of brown-field sites, inner cities with higher densities and retail and service development favor urban localities over out-of-town sites (Goodwin, 2012).

The reaction against urban sprawl controlling the spread and development of urban areas is primarily rooted in the sustainability and livability literature. Urban form and urban densities strongly influence urban travel since the compaction of cities can increase the intensity of urban areas to reduce motorized travel and increase social diversity and urban vitality (Echenique et al., 2012). According to Kenworthy and Lyons (2003), private motorized mobility is largely determined by the structure of the city and although private mobility arises from personal decisions of individual people, aggregate urban system behavior is influenced by the physical characteristics of the city.

Camagni et al. (2002) find that land consumption depends directly on the relative compactness of human settlements, while energy consumption depends only indirectly on those variables, via their linkage with mobility patterns, i.e. trip length and modal choice between private and public transportation options. The relationship between density and car use, however, is exponential and increased density reduces the length of travel in general, but also serves as a multiplier on the use of transit and walking/cycling (Newman and Kenworthy, 2011; Kenworthy and Laube, 1999).

4.5. GENERATIONAL SHIFTS AND LIFESTYLE CHANGES

"Millennials are in motion, but not necessarily by car" (Litman, 2014) – this is what many studies recently state about the Millennial generation dramatically shifting away from driving and that they're driving significantly less than young generations have in prior decades (Litman, 2014; Davis et al., 2012; Zax, 2014; Goodyear, 2014; Goodwin, 2012).

"This trend away from the automobile has been led by young people", as Davis et al. (2012, 1) find. From 2001 to 2009, the average number of vehicle miles traveled by 16- to 34-year olds decreased by 23% from 10,300 miles annually to 7,900 miles per capita. Only 46% of potential drivers of the age 19 and younger had driver's licenses in 2008, down from about 64% in 1998 (Zax, 2014).

Social standards such as acquiring a driver's license as a key rite of passage into adulthood no longer have the universality they used to, especially among young men whose propensity to learn to drive and purchase a car has decreased in many countries (Goodwin, 2012). The car seems to have been replaced by other products, icons and symbols. Especially, communication technologies have altered the way in which this digitally-native generation interacts and generates its new lifestyles. Young people consistently report a greater attraction to lifestyles that include less driving, i.e. urban living and residences in 'walkable' communities (Litman, 2014). The younger generation thus appears to place less value on vehicle ownership and suburban living due to combination of higher costs, improved travel options in cities and changing preferences (Santos et al., 2011).

ICT shows the potential for young people to substitute driving and supports alternative transportations. Car-sharing and bike-sharing programs enable many people to avoid purchasing a costly vehicle on their own, but still remain flexible in their transportation needs. Social media, too, has become a substitute for car trips as some young people who spend their time interacting with friends through virtual networks have less time and desire to drive to see someone (Davis et al., 2012).

A disproportionally large amount of young people seem to be using public transportation more often than in the decades before. "The Millennial generation seems to be defying its sheltered, suburban upbringing by delaying the acquisition of a driver's license and choosing transit" – 43% of under 30-year olds are reported to use transit at least once a week, compared to 12% of 30-60 year olds (Goodyear, 2014). Besides, according to a study conducted by Transit Center (2014) that aimed to understand the differences in attitudes and behaviors among the US population with respect to pubic transportation, age is key in determining the likelihood of public transportation use. Feelings about public transportation and urbanism considerably varied much more by age than by region. Despite having grown up taking transit and being encouraged by their parents to do so, Baby Boomers have become averse to riding on trains and buses. At the same time, Millennials, who grew up in the

backseats of their parents' cars, are turning to transit in large numbers and embracing it (Transit Center, 2014).
Davis et al. (2012) find that between 2001 and 2009, U.S. 16- to 34-year-olds:

- Reduced per capita vehicle-miles 23% from 10,300 to 7,900 annual miles;
- Took 16% more walk trips and 24% more bike trips;
- Traveled 40% more annual passenger-miles on public transit;
- Reduced the share that has a driver's license from 79% to 74%.

This phenomenon of decreased driving among younger generations is not unique to the U.S., but is becoming a characteristic pattern of developed countries. Studies in Sweden, Norway, Germany, the U.K. and Japan show the same trends (Davis et al., 2012).

4.6. SOCIAL EQUITY AND AFFORDABILITY

Costs and affordability around the automobile are other major factors impacting recent urban transportation trends. Litman (2006) names personal income and vehicle costs as primary reasons for why travel demand has changed over recent years. According to him, for many young people, insurance costs have been a large constraint on vehicle ownership – even more so than the purchasing costs of a car. Rising fuel prices play a role, too, even more in European countries where gas prices are significantly higher than in the U.S. Fuel prices are predicted to increase during the 21st century as demand grows and production peaks and although substitute fuels will become increasingly available, none is likely to be as cheap or convenient as petroleum was during the 20th century (Litman, 2013).
The notion of 'peak oil' goes along with 'peak travel' and 'peak car' as a shortage of fossil fuels will pose a global challenge to the transportation sector. Aftabuzzaman et al. (2011) name three major implications in the event of 'peak oil':

- A reduction of mobility for individuals;
- An increase of transportation disadvantages;
- A disruption of urban freight movement.

Further, global consequences will be rising oil prices and harder oil procurement which will eventually result in higher fuel prices and, most likely, contribute to reduced car use growth and decreased personal automobility (Newman and Kenworthy, 2011).
Affordability is closely linked to social equity and accessibility of transportation options. Current urban transportation trends and conditions indicate that many cities still remain inaccessible for many urban residents in spatial/physical as well as in socio-economic terms (UN Habitat, 2013). Though urban mobility systems aim at providing access to goods and services and enable people to interact and participate in social life, in reality people do not have equal access to urban transportation and

urban opportunities (UN Habitat, 2013). Replogle and Kodransky (2010) conducted a study comparing the urban transport divide related to accessibility constraints in the U.S. and Europe. They found that Europe showed a much less sharp divide than the U.S. when it comes to driving inequality of access. One major reason for that is that the housing and transportation choices of the U.S. working class are limited by a lack of affordable housing, only few transit options, and few jobs in residential areas. The working poor spend twice as much of their income on commuting as wealthier people and are regularly pushed to living far away from the urban core to find better and more affordable housing and access to higher wages, with long, costly commutes (Replogle and Kodransky, 2010).

5. ANALYSIS: FUTURE VISIONS OF THE AUTOMOTIVE INDUSTRY

5.1. INTRODUCTION TO THE METHOD

In this fast changing urban environment, car manufacturers around the globe are pursuing different mobility strategies to maintain and potentially grow their market shares. Ten global key car manufacturers were chosen for this study (see Table 1). They were selected based on their role in the automotive market and their global distribution with a focus on North America, Europe and Japan.

Table 1: Key car manufacturers selected for analysis

Company	Brands	Country
BMW AG	BMW, Mini	Germany
Daimler AG	Mercedes-Benz, Smart	Germany
Ford Motor Company	Ford	United States
General Motors Company	General Motors	United States
Honda Motor Co.	Honda	Japan
Nissan	Nissan	Japan
PSA Peugeot Citroën	Peugeot	France
Toyota Motor Corporation	Toyota	Japan
Volkswagen	VW, Audi	Germany
Volvo	Volvo	Sweden

A matrix was developed and used as a framework for the analysis of annual reports of the years 2005 and 2013 of ten major car manufacturers showing their growth strategies and mirroring the previously discussed urban trends. A list of the reports can be found in Appendix A. Analyzing their most current available annual reports of

2013 (published in 2014), as well as contrasting them to the reports from about a decade ago, shows how their strategies have changed over time and if urban trends that were taken into consideration over the years are different ones.
To complement the rather past-directed analysis of annual reports, current marketing materials and external communications taken from their official corporate websites indicating the companies' future directions of urban mobility were reviewed and analyzed.
Further, a survey was conducted in the form of questionnaires that were distributed via email to key strategists in the automobile industry and experts in the field with the goal to get an internal perspective on the car manufacturers responses to current urban trends as well as insights into how experts are reading the those trends. This research had the geographical focus of the United States, Europe and Japan.
Those experts were identified by contacting respective strategy and product planning departments of some of the car manufacturers with the intention to cover each geographical location.

5.2. ANALYSIS OF SELECTED ANNUAL REPORTS 2013

The annual report analysis of the selected ten key car manufacturers of their most recent available reports of 2013 (published 2014), revealed important information regarding the company's view on its past, as well as it gave some indication about their future pathways (see Table 2).
The matrix for analysis was set up in a way to check for the before discusses urban trends. Not only was the information whether and how the trends are mentioned in the reports important, but also whether they were mentioned in any way at all.

Table 2: Annual Report Analysis 2013

Company	**Acknowledgement of Changes**	**Demographic Changes**	**Rise of ICT**	**City Development**	**Lifestyle / Generational Shifts**	**Economic Factors**	**Other Urban Trends**
BMW	Increased demand in the USA and China; Decrease of 12.2 million units (1.8%) in Europe	Not mentioned (only mentioned with regards to own workforce)	Not mentioned	Not mentioned	"Demand for individual mobility no longer necessarily means actually owning a vehicle, therefore BMW is offering corresponding mobility services, such as the DriveNow car sharing model"	"Risks arising from economic developments, in particular a slowdown of economic momentum in China"; "Rising fuel and energy prices also exert an influence on customer behavior"	"One significant risk for the car industry is the possibility that laws ad regulations could be tightened at short notice, thus triggering the need for significantly higher levels of investment"
Daimler	Demand was different on the level of regions and countries: strong expansion of the Chinese market (+18%) and market growth in the US. Western European market smaller than in previous year (-2%); Germany -4%, UK: -10%	Not mentioned; only mentioned with regards to own workforce)	Implicitly mentioned ("Digital technologies are changing our products.... This is creating new business opportunities.... Including various mobility concepts, e.g. car2go, CharterWay, "moovel")	Not mentioned	Not mentioned (only in fine print as potential risk mentioned as "a shift in consumer preference towards smaller, lower-margin vehicles"	"Our future planning is based on the premises we set regarding the economic situation and on the development of the automotive markets"	"In addition to emission, consumption and safety regulations, traffic-policy restrictions for the reduction of traffic jams and pollution are becoming increasingly important in cities and urban areas"

Ford	Steady decline in sales volume in European market	Not mentioned	"We are taking an agnostic approach to enable and enhance customer's digital lifestyle."	Not mentioned	Not directed at generational shifts, but consumer preference in general. Risk factor of shifting consumer preferences away from larger vehicles	Mentioned as a risk factor "An increase in or continued volatility of fuel prices, or reduced availability of fuel"	"Many countries, in an effort to address air quality concerns, are adopting previous versions of European mobile source emission regulations"
GM	"Our vision is to sell our vehicles globally by targeting developed markets, which are projected to have increases in vehicle demand as the global economy recovers.."	Not mentioned	not mentioned	Not mentioned	Not mentioned	"Shortages of and increases or volatility in the price of oil" mentioned as a risk factor	None
Honda	"Total demand in Europe decreased by approx. 8% from the previous year"; "In Asia, in calendar year 2012, total demand increased approximately 13% from the previous year mainly due to market expansion in Indonesia and India"	Not mentioned	New technologies mainly focused on advances of powertrain technologies / efficiency	Not mentioned	"Core R&D programs focus on (1) creating new technology for developed countries to take account of socioeconomic, lifestyle and energy use changes...."	"Management mainly consider economic trends of each region, demand trends, situation of competitors and our business strategy in determining the future of projects"	"Structural changes in the global economy due to greater awareness of environmental issues worldwide and the growth of emerging countries have had a significant impact on our business activities"

Nissan	"During fiscal 2012 Nissan faced difficult conditions on many fronts, including sluggish demand due to the sovereign debt crisis in Europe and the impact on Japanese automakers of the islands issue that broke out with China in September"	Not mentioned	New technologies focus on improving fuel efficiency in internal combustion engines	Not mentioned	Not mentioned	Not mentioned	"Like other Japanese automakers operating in China, the company was negatively impacted by political tensions and demonstrations surrounding the islands dispute"
PSA	"After contracting by 8.6% in 2012, the European automotive market as a whole edged back by a further 1.6% in 2013"	Not mentioned	Research project with Bosch to increase the driving range of future hybrid and electric vehicles, through optimized energy management, enhanced driver safety and comfort with navigation data and on-board camera and radar system"	Not mentioned	Not mentioned	Not mentioned	"The increase in man-made CO2 emissions has led governments to implement control and regulatory measures to limit the effects of human-generated greenhouse gases"

Toyota	"Each of the markets in which Toyota competes has been subject to considerable volatility in demand.	Not mentioned	"We view ITS technology as a valuable way to link motor vehicles and transportation infrastructures"	Not mentioned	"Cars will change the lifestyle of the future"	"Demand may also be affected by factors directly impacting vehicle price or the cost of purchasing and operating vehicles.."	"City traffic poses the greatest technical challenge for modern driver assistance systems"
Volvo	"The shift away from larger to smaller more fuel efficient models continues"; "consumers in larger emerging markets such as Brazil, Russia, India and China are seeking bigger and more luxurious cars"	Not mentioned	"Autonomous driving project in Gothenburg in 2017 - will be the world's first large-scale autonomous driving pilot project"	"Strategic risks result from sustainability mega-forces like population growth, urbanization, resource scarcity and climate change"	Not mentioned	"Consumers remain financially constrained - fuel efficiency is becoming a key factor when it comes to deciding which car to buy"	"Self driving cars for sustainable mobility"
VW	"We estimate that the demand for passenger cars worldwide will continue to increase in the period 2015 to 2018"	Not mentioned	"The primary focus in on augmented reality technology, in which the real world is recognized and enriched with virtual information"	"Greater urbanization is creating noise and air pollution in megacities, so that governments had to introduce emission controls"	Not mentioned	Demand impacted by increased fuel prices...	Climate change and the target agreed by governments worldwide to reduce CO2 emissions by some 90% by the year 2050..."

All ten car manufacturers acknowledge changes regarding the demand in the automotive industry in recent years. They all report a considerable volatility in demand (Toyota, 2014), but acknowledge differences on the level of regions and countries (Daimler, 2014). Seven out of the ten specifically mention the decrease in demand and sales in European markets ranging between 8%-10% (BMW, 2014; Daimler, 2014; Ford, 2014; Honda, 2014; Nissan 2014; Peugeot, 2014; Volvo, 2014). On the other hand, some of them saw an increase in total demand, mainly however, due to market expansions to emerging markets like Indonesia and India (Honda, 2014) or Brazil and Russia (Volvo, 2014), strong expansion of 18% of the Chinese market (Daimler, 2014) and a even growth of the U.S. market (Daimler, 2014; BMW, 2014). However, the overall picture shows declining trends in the Western world, but potential increases in emerging markets such as Brazil, Russia, India and China.

Demographic changes with regards to an ageing society and its implications for the future of mobility were not mentioned in any of the annual reports. Changes in demographics were only mentioned with regards to the company's own workforce and what risks were implied concerning pension funds and new working models.

The rise of Information and Communication Technologies (ICT) were mentioned in about half of the reports referring to "digital technologies that are changing our products" (Daimler, 2014) or the vision to "take on an agnostic approach to enable and enhance customer's digital lifestyle" (Ford, 2014) and viewing "ITS technology as a valuable way to link motor vehicles and transportation infrastructures" (Toyota, 2014). Most of the technology-related information mentioned, however, referred to new combustion technologies and advances of powertrain technologies to improve fuel efficiency, optimized energy management or driver safety (Peugeot, 2014; Nissan, 2014; Honda, 2014).

Changes in city development, increasing urbanization and an increasing density in cities were only mentioned by two car manufacturers. Volvo (2014, 20) refers to "strategic risks resulting from sustainability mega-forces like population growth, urbanization, resource scarcity and climate change". Volkswagen (2014, 122) acknowledges that "greater urbanization is creating noise and air pollution in megacities, so that governments had to introduce emission controls". Still, even though those two manufacturers affirm the trends of urbanization and population growth, they neither go into detail of what that means for the future of urban personal transportation nor their solutions regarding this development.

While four out of ten car manufacturers mentioned potential lifestyle changes in their annual reports of 2013, only one of them acknowledged that "demand for individual mobility no longer necessarily means actually owning a vehicle" (BMW, 2014, 70) and that "therefore, BMW is offering corresponding mobility services, such as car sharing models". The other three companies mentioned lifestyle changes with regards to potential risks of shifting consumer preferences – mostly away from larger vehicles.

Toyota (2014, 19) even turns it around with their statement that “cars will change the lifestyle of the future”.
Economic factors influencing the future demand for personal automobiles are mentioned by almost all of the car manufacturers. However, while most of them acknowledge the increased fuel prices or continued volatility of fuel prices (Ford 2014; GM, 2014) only some of them make the connection to the influences on customer behavior stating that “demand may be affected by factors directly impacting vehicle price or the cost of purchasing and operating vehicles” (Toyota, 2014, 46) or that “fuel efficiency is becoming a key factor when it comes to deciding which car to buy” (Volvo, 2014, 14). The uniform answer to this seem to be technological advances in fuel efficiency that are supposed to encounter this challenge.
When analyzing the reports for further trends and factors that the car manufacturers see as potentially influencing the future of urban mobility, there was a clear focus on emission regulations. “Climate change and the target agreed by governments to reduce CO2 emissions by some 90% by the year 2050” (Volkswagen, 2014, 122) and “the increase in man-made CO2 emissions has led governments to implement control and regulatory measures to limit the effects of human-generated greenhouse gases” are examples for what has uniformly been pictured as one of the major risk factors impacting the future of their business strategies (BMW, 2014; Daimler, 2014, Ford, 2014; Honda, 2014; Peugeot, 2014; Volkswagen, 2014).
Other challenges mentioned were political tensions between China and Japan (Nissan, 2014) and traffic jams and city traffic (Daimler 2014; Toyota, 2014).
The car manufacturers responses to those challenges, circle around the idea of technological advances - regarding fuel efficiency.

5.3. ANALYSIS OF SELECTED ANNUAL REPORTS 2005

The same ten key car manufacturers were chosen to study their annual reports from 10 years ago (2005), to see potential changes in directions and observation of urban trends influencing the future of mobility (See Table 3).
The picture of changes in demand shows very dispersed directions. While part of the manufacturers predict a global economic upswing (BMW, 2006) or state that “demand was favorable in almost all major markets during 2005”, others acknowledge that “the global automotive marketplace has become increasingly fragmented and crowded” (Ford, 2006, 24) and that sales in many markets have decreased or stagnated (Daimler, 2006; GM, 2006; Peugeot, 2006).

While none of the car manufacturers mentioned demographic changes and an ageing society as urban trends influencing the future of mobility in the annual reports of 2013, the same picture holds true for 2005. Only BMW (2006, 11) mentions that “it

is important to prepare for global challenges such as demographic change and the transition to the hydrogen age". Still, there is no further explanation as to what the company intends to do about it.
The rise of ICT is not mentioned in any of the annual reports. Technological changes focus on new environmentally compatible technologies (BMW, 2006), new drive-system technologies (Daimler, 2014) or the enhancement of road safety (Peugeot, 2006). Most alternative drive technologies focus on fuel-cell drive (Daimler, 2014), the use of liquid hydrogen as the fuel of the future (BMW, 2006) and electric and hybrid electric driving technologies (Nissan, 2006; Ford, 2006).
Changes in city development and increasingly urbanization were not mentioned in any of the annual reports of 2005.
The same goes for changes in lifestyle and generational shifts. None of them were mentioned in a way as to potentially influence the future of their business strategies or the future of our urban transportation systems. Only Nissan (2006) and Ford (2006) stated the goal to attract younger customers, mainly through new technologies and designs. There is no indication, however, that there is a risk of younger generations turning away from the personal automobile.
Economic factors are once again mainly aimed at bigger macroeconomic changes influencing the customers' sensitivity towards fuel prices (Peugeot, 2006; Volkswagen, 2006). The response by the automotive industry has been the same over the years, since even back in 2005/2006, they acknowledge to "have made many advances in technologies" (Honda, 2006) to encounter the threat of financially constrained customers.

Table 3: Annual Report Analysis 2005:

Company	**Acknowledgement of Changes**	**Demographic Changes**	**Rise of ICT**	**City Development**	**Lifestyle / Generational Shifts**	**Economic Factors**	**Other Urban Trends**
BMW	"BMW predicts that the global economic upswing will continue in 2006"; most growth expected in China and India	"It is important to prepare for global challenges such as demographic change and the transition to the hydrogen age" – however, focus mainly on own workforce	Not mentioned; Focus on new environmentally compatible technologies; Commitment to the use of liquid hydrogen as the fuel of the future	Not mentioned	"Growing trend, particularly amongst younger customers, to obtain financing via the Internet"	Not mentioned	None
Daimler (DaimlerChrysler)	US market: decrease in sales Western Europe: stagnating sales Japan: decrease in sales	Not mentioned	Not mentioned; Focused on own innovations: new drive-system technologies, esp. hybrid drive and fuel-cell drive	Not mentioned	Not mentioned	"Sales decreased in the US due to an increase in fuel prices"; "Demand was influenced more than ever by manufacturers' product and price strategies"	None
Ford	"The global automotive marketplace has become increasingly fragmented and crowded.."	Only mentioned regarding own workforce (pension plans)	Focus on new environmentally-friendly technologies (esp. hybrid-electric, hydrogen, ethanol)	Not mentioned	"The agile V8 Vantage helps advance a strategy to reinvigorate and attract younger customers to the brand"	Rising gasoline prices had an adverse effect on the demand for full- and medium-sized sport utility vehicles in the US	None

GM	Decline in volumes was the effect of unfavorable product mix → fewer sales of higher margin large trucks and large cars	Not Mentioned	Not mentioned	Not mentioned	Not mentioned	"Fuel prices increased sharply through the year, reducing demand for some of our highest-profit trucks"	None
Honda	""The industry situation for motorized products in on the rise"	Not mentioned	Not mentioned	Not mentioned	Not mentioned	"Due to everyone trying to save money on gas, Honda has made many advances in its hybrid technologies"	None
Nissan	Trying to expand to new emerging markets	Not mentioned	Not mentioned, only internal technologies (fuel cell, electric and hybrid electric)	Not mentioned	Not mentioned; only implicitly as a goal to attract younger customers	"The fuel price situation has naturally affected sales"	None
PSA	"Sluggish demand expected in Europe, growth elsewhere"	Not mentioned	R&D programs focusing on enhancing road safety, reducing emissions & improving fuel efficiency	Not mentioned	Not mentioned	Acknowledging customers' sensitivity towards fuel prices	None
Toyota	Not mentioned	Not mentioned	Not mentioned, only regarding developing environmental technologies	Not mentioned	Not mentioned	Not mentioned	None

Volvo	"Demand was favorable in almost all major markets during 2005."	Not mentioned	Not mentioned; only regarding own new technologies to reduce emissions	Not mentioned	Not mentioned	Not mentioned	Increasingly difficult traffic situation in many large cities
VW	"Expecting slight growth in global demand for automobiles in 2006"	Not mentioned	Not mentioned; only regarding own development of alternative drive technologies → to satisfy large number of customers for environmentally conscious mobility	Not mentioned	Not mentioned	"Negative impact of higher fuel prices, poor economic performance and continued high unemployment"	"Customer preferences vary enormously in our markets across the globe"

5.4. MEDIA AND EXTERNAL COMMUNICATIONS ANALYSIS

BMW

At the end of 2007, the BMW Group launched its Mobility of the Future Project "project i". It named global developments such as climate change, limited resources and growing urbanization as the reasons for why people increasingly become aware of their social responsibility and, therewith, the premise of individual mobility is also changing. Further, the EU has made clear its aspiration to reduce the emissions of climate-damaging greenhouse gases by 20% compared to 1990 by the year 2020. The BMW Group foresees a future with electro-mobility. In 2008, at the LA Motor Show, BMW presented their electric vehicle Mini E as the first result of its "project i". In 2011, a fleet of test cars was handed over to customers gaining important knowledge to develop new innovative solutions in the field of electro mobility.

Apart from the development of its electrified cars for the future, the BMW group is also highly involved in traffic management projects and mobility services. On their website, they state that "together with partners, concepts are being developed for connecting vehicles to their environment by means of the most modern technology available".

Daimler

On Thursday, November 20th, 2014, the CEO of Daimler AG and Head of Mercedes-Benz Cars, Dr. Dieter Zetsche held a lecture at Oxford University, UK, that was also live-streamed over the Internet. Expecting the automotive industry to see more changes in the next 10 years than it had seen in the last century, Zetsche provided his views on the most significant automotive trends and the biggest potential paradigm shift in the industry and our everyday lives and how his company, Daimler, is responding to those urban trends. He named four drivers of change for the future of the automotive industry: population growth, urbanization, new regulations and digitalization.

Traffic is expected to get worse and with denser city developments and increased urbanization, private space will become more of a luxury good. According to him, autonomous driving offers an increase in the quality of life for people, as it will create a new private space, a 'place of rest and relaxation'.

The car has been a symbol for personal freedom for over 100 years – the self-driving car will represent even more personal freedom as it gives people the opportunity to relax and use their time for other things while getting to their destination.

Overall, Daimler sees the future of mobility in self-driving cars. On their website, they state "autonomous driving will gradually become a reality". However, Daimler's Head of Driver Assistance and Chassis Systems admits that much needs to be done to raise the public's awareness of autonomous driving. He thinks that there is a difference between digital natives that have a great confidence in technology and are willing to

rely on it in many situations and people who did not grow up in this technological era. He also acknowledged a completely different target group of people who will reach the age of 60 or above in the next decade. For them, autonomous driving systems could fulfill a different function of using the systems to supplement their own gradually decreasing sensory capabilities of the road. Asked about the interaction of autonomous and traditional vehicles, he explained that there will still be a long, though not indefinite, period during which both types of vehicle will be on the road.

Ford

On their corporate website, Ford states that "by 2050 we will have a true network of mobility solutions, and automobiles will likely look very different from how they look today". Through vehicle-to-vehicle communications, vehicle-to-infrastructure technologies, in-car mobile communications and interfaces, electrified vehicles and digital maps and cell-based communications Ford Motor Company envisions the mobility of our future. They portrait a long-term vision for 2025+ expecting:

- A radically different transportation landscape in which pedestrians, bicycle, private car, commercial and public transportation traffic will be woven into a single network;
- The arrival of smart vehicles capable of fully automated navigation;
- The development of a true network of mobility solutions, with personal vehicle ownership complemented by greater use of connected and efficient shared services, and completely new business models contributing to improved personal mobility.

GM

General Motors acknowledges that increasing urbanization will put tremendous pressure on public infrastructure in the future. Their vision to address the need for personal mobility is through a radical change in personal urban transportation presenting their new vehicle form called EN-V. EN-V stands for Electric Networked-Vehicle and is a two-seat electric vehicle designed to alleviate surrounding traffic congestion, parking availability, air quality and affordability for tomorrow's cities.

Honda

Honda presents itself as an organization that is dedicated to the advancement of mobility targeting leading-edge technologies. "From our racing spirit to our dedication to our environmental leadership, it is Honda's mission to develop forward-thinking technologies that anticipate and satisfy the needs of a future society." However, what is interesting is that they actually seem to focus on mobility solutions that aren't limited to city streets. Honda just recently unveiled new personal mobility devices that are built for walking. Those walking assist devices with bodyweight support systems are not the only solutions Honda presents regarding mobility. ASIMO, one of the world's most

sophisticated humanoid robots, was created to make people's lives easier taking over mobility-related activities.

Nissan

Nissan's latest direction has been to develop new technologies inspired by the animal kingdom that will shape the future of mobility. It states on its website that their longer-term R&D goals are to achieve virtually zero fatalities and serious injuries. Therefore, studying the behavior of animals moving in groups helps engineers at Nissan understand how vehicles can interact with each other for a safer and more efficient driving environment. That's how the researchers created the EPORO robot, inspired by the bumblebee's compound eyes that can see 300-degrees. Six EPORO units will communicate among themselves to monitor each other's positions to avoid collisions as well as be able to travel side-by-side, thus exhibiting the behavior of fish swimming in schools.

PSA

Peugeot is committed to developing new, more environmentally and community-centered mobility solutions and aims to set standards for sustainable mobility. On the technological side, it is currently following the hybrid technologies, combining a diesel engine and an electric motor to build low carbon vehicles for all customer profiles. Besides, it sees electric vehicles as an increasingly credible alternative for urban mobility and expect cities to soon install the necessary infrastructure. However, Peugeot does acknowledge that convenient mobility solutions for future customers do not systematically involve owning a car. Therefore, they aim to enhance their existing offering and devise the services of tomorrow with a focus on mobility and networking, e.g. web portals and online services.

Toyota

In March 2011, Toyota unveiled its "Toyota Global vision" for the future of mobility. They state that "creating always better cars" is their main focus as an automaker. In order to realize safer, more ecological and more comfortable mobility, they have been focusing on Information Communication Technologies (ICT) and Intelligent Transportation Systems (ITS). The automobile is no longer just a means of transport for them, but plays a larger role in society. In this smart mobility society, vehicles will contain new kinds of attractive and value-added functions and features that closely connect all aspects of human activity and life as part of smart communities worldwide. Ultimately, Toyota aims to utilize advanced Information Communication Technologies (ICT) to create a smart mobility society – a society in which people smile thanks to the peace of mind, excitement and happiness afforded by their connection to their vehicles and their communities.

Volvo

At the end of 2013, Volvo announced a pilot project in the city of Gothenburg, Sweden, testing self-driving cars on real public roads. The project was called "Drive Me – Self-driving cars for sustainable mobility" and aimed at discovering the societal benefits of autonomous driving. Further goals were to determine infrastructure requirements, traffic situations suitable for autonomous control, customers' confidence in the vehicles and how surrounding drivers interact with a self-driving vehicle. The Volvo Group sees major benefits through the technology, such as improvement of emissions, alleviation of traffic, making driving more relaxing as well as safer. Beginning in 2014, the pilot project started with customer research and technology development. The first real cars, however, will only be tested after 2017.

VW

Volkswagen sees globalization, urbanization and individualization as key drivers having an influence on future developments in industry and society. Volkswagen Group Research tries to integrate these trends in revolutionary automobile concepts, focusing on powertrain, body, operation and safety. Volkswagen's future research concentrates on the early recognition of new technology and new social trends and on technology road mapping.

It sees the key in the interaction of intelligent roads, innovative traffic management and further developed vehicle technology on an intact infrastructure.

6. SURVEY: HOW ARE EXPERTS IN THE FIELD READING THE TRENDS?

6.1. INTRODUCTION TO THE METHOD

Qualitative data were gathered using original surveys that were sent out via email to selected experts of the automotive industry. The goal was to get an internal perspective and expertise on how they see current urban trends influencing urban travel behavior with regards to the automobile. Ten surveys were sent out to experts in the strategy and product planning departments of car manufacturers in Europe, Japan and the U.S, to which five people from Europe and Japan replied and participated. The survey included the following questions, which were reviewed and approved by the institutional review board (IRB):

1. What do you see as the most critical urban trends that influence personal urban mobility and, specifically, car usage?
2. Do you notice changes in travel behavior or car drivers in your country?
3. Do you see demographic changes influencing motorized transportation? If yes, how?

4. How are information and communications technologies influencing motorized transportation?
5. Are current city developments, e.g. higher densities in cities, influencing motorized transportation?
6. How are lifestyle changes and generational changes influencing motorized transportation? Do you see a different travel behavior in our current young generations, compared to older generations?
7. Are economic factors influencing motorized transportation?
8. How is your company reacting to currently changing urban patterns? How is it defining its role as a mobility provider of the future?
9. Where do you see the future of urban mobility going?
10. Do you see the self-driving car as the future of mobility? If yes, why? If no, why not?

The 10 questions of the survey were mainly aimed at supplementing and potentially contrasting the findings of the literature review and the annual report and media analysis and were therefore designed to cover the urban trends discussed before.

6.2. SURVEY RESULTS

Ten surveys were sent out to car manufacturers of which five responded (Europe n=2; Japan n=3).

The opening question of the survey “What do you see as the most critical urban trends that influence personal urban mobility, specifically, car usage?” received, as expected, a broad range of answers, including traffic jams, low speed transportation, lifestyle changes, ICT. Interestingly, respondents from Japan focused their answers on city density, population growth and resulting traffic jams and low speed transportation, whereas respondents from Europe named the increased awareness and growing fear of air pollution and harmful impact of excessive emissions as major urban trends.

The answers as to whether the experts are noticing changes in automotive travel behavior diverged with two people not seeing much changes in their own environment. Both of them stated that they know about the statistics of reduced automotive travel but that the streets are still overflowing and people are stuck in traffic jams. However, the remaining three surveyees mentioned the significance of urbanization a resulting decrease in car ownership, especially amongst the younger generations. In Japan, as well as in Germany, the experts see the younger generations being less interested in owning a personal vehicle. New services like midnight bus services in Japan, car sharing in major cities, or the liberalization of long distance busses in Germany were named to have become an alternative for city-to-city transfer and urban transportation.

Most of the respondents see demographic changes significantly influencing motorized transportation stating that the aging population will play a major role in most markets in the future, with more elderly people losing the ability to drive and technological developments towards user-friendly transportation and ease of use to counteract this development.

All of the experts see information and communications technologies as a major driver of change on the motorized travel behavior especially with regards to transportation control systems, driving assistant systems. One expert sees ICT as the major driver for innovation of the entire automotive industry in the next 10 years and believes that we will see further trends towards integration of information technologies and communication technologies in vehicles, from the integration of personal devices to vehicle to grid communication to vehicle-to-vehicle communication.

Especially in Japan, the respondents see higher density in cities influencing travel behavior towards an increased use of transit and smaller motorized vehicles. While experts from Japan emphasized increasing city density and resulting abandonment of the car an urban trends, European experts focused more on policy-related developments as major influences in this regard. They see new environmental regulations and 'Green policies' considerably pushing people towards the usage of alternative drive vehicles, such as electrified and electric vehicles. At the same time, German cities are cited to introduce more and more 'Green policies' such as the reconstruction of roads with separate bicycle lanes and tighter roads for car traffic, inner-city speed limit reductions, new traffic light regulations and subsidized or free annual tickets from the public transportation system for municipal employees.

Answers to whether the experts see generational and lifestyle changes influencing travel behavior differed greatly from seeing young people travelling 'more globally' than their generations before, not seeing any changes or seeing considerable changes towards the car. Those acknowledging changes mainly mentioned a decreased interest in cars by young people, lesser focus on luxury brand cars, preference of smaller cars and an increased usage of car sharing services. Further, a changed travel behavior of young people was noted stating that young people prefer to meet in cities rather than going for drives outside the city. The role of luxury goods has changed, possessing technological devices like iPhones and iPads instead of valuing the ownership of a private car.

All of the respondents agreed on economic factors influencing travel behavior referring mostly to increased total cost of ownership, increasing oil/fuel prices influencing buying behavior of people. With increased total cost of ownership, people are expected to buy fewer cars and drive less.

The question of how the expert's company is reacting to the changing urban environment was only answered in three out of the five surveys. Particularly in Japan a strong dependency and cooperation with the government was mentioned. Taking

into consideration the current government direction, company strategies are aligned mainly focusing on alternative drive vehicles and less emissions.
The rather open-ended question where the expert see the future of mobility was only answered in two surveys expecting cars to still be important, but that autonomous driving and new technologies will play a bigger role.
All of the respondents see the self-driving car playing a major role in the future of transportation. They see it as a more comfortable, safer and more energy efficient solution. It is expected to gain a big market and redefine not only the car, but also the entire transportation system.

7. DISCUSSION

7.1. FINDINGS

This section brings together the urban trends discussed in the literature review with the original primary data collected through the annual report analysis, the media and external communication analysis as well as the surveys.
The annual reports of 2013 of the selected ten key car manufacturers all acknowledged changes in the demand and sales of the automobile. Demographic changes, an ageing society, urbanization and generational shifts of younger generations away from the automobile, however, have barely found mentioning and, accordingly, did not implicate any strategies to encounter those urban trends. The three urban trends that were mentioned and described the most in the annual reports were the rise of ICT, the influence of economic factors as well as increasingly strict emission regulations. Overall it almost seems like the future directions of the car manufacturers are mainly influenced by external developments and regulations that force them to change their business strategies and products. Those requirements are mainly intended to be met through technological advances in fuel efficiency and clean combustion technologies.
Comparing those results to the annual reports from a decade ago (2005), not much has changed. Back then, as well as presently, demographic changes, urbanization and lifestyle changes seem to not have played a major role in the strategy formulation of the car manufacturers. ICT has only evolved and manifested its role quite recently, and so did the increasingly strict emissions regulations. The main differences can be found on the technological side where 10 years ago, the focus seems to have just shifted to an environmentally compatible way of fueling the cars, seeing hydrogen and fuel-cells as well as hybrid technologies as the engines of the future.
The media and external communication research gave insights into more future-directed statements and directions of the carmakers. All of the car manufacturers have a vision for the future of mobility formulated to some extend. The main strategic

focus of the car manufacturers from a technological standpoint seems to be electrified vehicles and self-driving cars. Almost all of them explicitly state that they are actively trying to change their own strategies. What this future looks like, however, is a picture that varies from car manufacturer to car manufacturer and so do their strategies of how to prepare for this future. Nissan, for instance, is studying the behavior of animals moving in groups to gain knowledge about safe and efficient movement of vehicles. Peugeot is following a more service-oriented approach offering options to integrate mobility networks. Honda shifted its focus to robots and other personal mobility devices. Toyota seems to focus on Information Communication Technologies and their integration into Intelligent Transportation Systems. Volvo and Daimler are both ascribing most potential to fully-automated driving as the future for our urban transportation system. However, while almost all of them seem to see the solution in technological advances and responding to their identified urban trends with technological solutions, their described visions seem hesitant and quite vague.

The results from the surveys complemented the previously gathered data in terms of giving it a regional focus and differentiation (Europe and Japan) as well as there was room for some more detailed, personal thoughts.

While all of them recognized shifts in personal urban mobility in recent years, respondents from Japan focused more on city density, population growth, urbanization as well as an ageing society, whereas respondents from Europe placed major importance on environmental regulations and legislative developments. All of them agreed that there is a trend towards smaller motorized transportation and an expansion of the role of transit and car sharing services. The liberalization of long distance buses and investments in public transportation, especially in Europe, were seen as having a major impact on the future of owning a personal car.

Overall, it seems like changes in personal transportation in Europe were more driven by environmental legislation and emission restrictions, with answers of the car industry towards emission-free driving and an increased fuel-efficiency, whereas in Japan there seems to be an emphasis on population growth, increase of density and increasing urbanization as a driver towards to usage and integration of information and communication technologies and intelligent transportation systems.

Looking at the overall results of what the data analysis and the surveys revealed, there seems to be a certain disconnect between some of the urban trends and how or whether the car manufacturers are seeing those same trends. Their answers uniformly point towards technological advances and, mainly, to more automated driving technologies, intended to ultimately lead to fully automated driving.

7.2. IMPLICATIONS FOR CITY PLANNING AND NATIONAL GOVERNMENTS

It is certainly true that motorized travel has grown tremendously during the 20th century due to favorable demographic, economic and technical trends. However, this growth is unlikely to continue and current urban trends are causing motor vehicle travel to peak in most developed countries. Although automotive travel will most likely continue to play an important role, a saturation of vehicle ownership, an ageing society, rising fuel prices, increasing urbanization, as well as changing consumer preferences especially among younger people, are all contributing to a reduction in automobile travel and an increasing demand for alternative modes. More and more people prefer to use the car less and rely more on alternative modes, provided that they are comfortable, convenient and affordable (Litman, 2013). However, current transportation planning often fails to account for changing travel demand. While automobile-oriented transportation planning was justified when vehicle demand was still growing, the road network was still underdeveloped, there were economies of scale in vehicle and road production and it received broad public support since people could personally experience the benefits of expanding and improving automobile travel, this justification is no longer valid (Litman, 2013). Changing consumer demands have to be taken into consideration and underlying factors causing the change have to be investigated in order to execute "good planning". Various transportation policy and planning reforms are needed to respond to these changes in travel demand including a more comprehensive and multi-modal planning and less emphasis on roadway expansion. While transportation used to be defined as mobility in terms of physical travel, there needs to be a paradigm shift towards accessibility with an emphasis on people's ability to reach desired services and activities using multiple modes of transportation ranging from walking, cycling, public transportation, telework, car sharing or the private automobile (Litman, 2013). National governments, together with their city planning departments and agencies, need to think outside the box and try to find solutions of how to incorporate all modes of transportation into a multi-modal transportation system. A re-structuring of taxation and tax incentives for different transportation modes and services could prove to be a helpful tool in direction-setting.

7.3. IMPLICATIONS FOR AUTOMOTIVE INDUSTRY

The analysis of urban trends showed that customer preferences and requirement profiles are shifting. Individuality, flexibility, optimized costs as well as environmental consciousness play an increasingly important role, while vehicle size and engine performance are becoming less prominent evaluation criteria. As a result, the car industry is confronted with the challenge of balancing their expensive

investments in sustainable vehicle design, more efficient engines and new technologies and shifting customer demand on the other hand. In the future, people will be less likely to commit to the purchasing of one product that they will possess for a long period of time, but at the same time, their sustainability and flexibility requirements are likely to further increase. To be able to stay profitable in the future, automotive companies will have to question their established business models and find new innovative ways to fulfill future mobility requirements. A new definition of their future business models should be from an automotive, product-oriented on to a mobility and accessibility providing one. A goal should be to link the product to future networked, multimodal cities and hence to become a mobility service provider focusing on access by establishing a diverse mobility service portfolio.
Further, there should be considerations to integrate the private sector of the automotive industry with public entities and national governments.

7.4. RECOMMENDATIONS AND FURTHER RESEARCH

The disconnect between current urban trends and the strategies pursued by major car manufacturers lead to the question of how the governmental and especially the city planning side and visions look like. Fully automated driving requires major changes in the urban built environment. Realizing those changes would require enormous changes in street infrastructure. Spacing of streets, curbs and regulations of who can go where would have to be re-evaluated and newly defined. Those changes are likely to be very cost-intensive. At them moment it seems unclear who and if anyone is pushing for those changes in cities of developed countries. This also explains to a certain extend the car manufacturers' hesitant attitude towards actually realizing their visions of self-driving cars. Another aspect to consider is that newer developments show that not only car manufacturers but also major technology firms like Google and Apple seem to be the ones pushing for those technological changes.
However, even though it seems to be very likely at the moment that the technological side of the self-driving cars is possible and that therewith the car manufacturers' technical solution could be working, there is still the major disconnect between the realization of those in a real urban environment.
Therefore, my major recommendation is that future research should aim to get insights into country- and city-directions of how they envision the future of our urban transportation systems, as well as ways to incorporate individual agendas into one multi-modal transportation strategy.
Further, especially from a car manufacturer's perspective, there should be more emphasis on how to deal with an increasing urbanization as well as an ageing society. The projected population growth combined with an increased urbanization will have

major impacts on the city's built form and future urban development. City densities are likely to increase and personal private space will become more scarce. Following the single approach of developing electrified and self-driving vehicles, and considering basics of space requirements, it might result solely in a re-invention of the bus or the train. Cities only have a limited amount of space left. If more people were to switch to personal urban transportation, e.g. in forms of self-driving cars, traffic jams would inevitably be arising and people would once again be stuck in traffic.

One major challenge will be to actually find this appropriate role for the private sector and getting those companies to contribute and commit to the development and subsequent realization and link this to city visions and their future strategies. New systemic solutions are needed for our future urban transportation system that take into consideration the changing consumer demands and current urban trends and that are supported by various forces, in particular national government, city planning agencies as well as private sector enterprises.

The solution for our future urban transportation system might lie in a highly fragmented, pick-and-choose mode of transportation system that integrates different modes of transportation and that is therefore suitable for individual requirements and needs. To move forward, it will be important for car manufacturers to widen their business models and definitions of traditional car manufacturers to mobility (service) providers. This would include switching from measuring market share to measuring mobility share as an indicator for success. Car companies could even take over the role of mobility integrators by not only supplying the products and services, but also adding technologies like smartphone apps to integrate the different mobility options. Car manufacturers could be the ones linking private and public transportation by, for instance, leasing self-driving cars to customers on a short or medium-term basis.

A global traveling budget could be an idea to integrate traveling options on a global scale, for instance by providing services that are integrating air travel as well as city travel.

The private sector often plays a key role in moving technology from "proof of concept" through development on to implementation (Deakin et al. 2009). However, as shown throughout this thesis, car manufacturers seem to be "whistling past the grave yard" and are stuck in their need to defend the technologies they have invested so much in. It reminds of a "chicken and egg situation" where governments and car manufacturers are stuck in: Car companies have started investing in autonomous driving technologies and electrified driving. On the other hand there is not yet sufficient infrastructure in place that would assure potential future customers to actually buy one of those new innovative vehicles. At the same time, city planning in many cities all over the world has not yet embarked on a specific future urban transportation strategy and seems to somehow still hold on to automobile-oriented planning principles, slightly increasing investments in public transportation but remaining hesitant to formulate an overall, integrated and networked future vision

for our urban transportation system. Solving urban mobility challenges will require system-integrating innovations that require public as well as private support. Establishing a collaborative platform to align objectives and prioritize common goals could lead to a common vision and the articulation of future strategies. In doing this, national governments should play a key role in opening up the dialogue between governmental agendas, city planning and the private sector to find solutions not only on the side of the transportation medium itself, but also on the transportation environment, as space in cities is limited.
Lastly, I recommend further research regarding transportation trends and the future of transportation in rural areas as well as in developing countries as these indicate to entail quite different developments and future trends.

8. CONCLUSION

This thesis aimed to explore current urban trends that are influencing the future of our urban transportation system as well as recent answers from the automotive industry as to how they see those trends and how their future strategies look like. Most of the urban trends described in this thesis were taken into consideration by the car manufacturers in some way. However, many times it did not go beyond the acknowledgement of the existence of a specific urban trend and their responses seemed rather vague as to where the future of urban transportation is going. In most cases there is a focus on a technological fix of all challenges being faced in the future urban environment.
Though there are certainly many synergies and advantages to explore through the employment of more technology, for instance through ICT and ITS that can certainly alleviate some congestion problems as well as increase driver safety, it is most likely not the only answer. Some car manufacturers already started looking into more holistic approaches trying to create networks of mobility by integrating shared mobility services and mobile platforms. Further integration could happen towards exploring integration of transit options and other mobility options, and, for instance, an integration of private and public forces.
Most importantly, however, there needs to be systemic solution that integrates and aligns national as well as city interests with the interests and direction of the private sectors and mobility providers. Only if all interests are aligned there is an actual chance for a change in our future urban transportation system that is not solely based on a wait-and-see approach.

9. BIBLIOGRAPHY AND REFERENCES

Aftabuzzaman, Md. and E. Mazloumi (2011) 'Achieving sustainable urban transport mobility in post peak oil era', Transport Policy, 2011, ISSN: 0967-070X, Volume 18, Issue 5, p. 695

Althaus, H.J. (2012) 'Modern individual mobility', The International Journal of Life Cycle Assessment, 3/2012, ISSN: 0948-3349, Volume 17, Issue 3, p. 267

Altshuler, A (1979) The Urban Transportation System: Politics and Policy Innovation, MIT Press, Cambridge, Massachusetts

Armstrong, J. (2011) 'Alternative railway futures: growth and/or specialisation?' JOURNAL OF TRANSPORT GEOGRAPHY, 11/2011, ISSN: 0966-6923, Volume 19, Issue 6, p. 1570

Bailey, L. (2004) Aging Americans: Stranded without Options, Surface Transportation Policy Project 2004, http://www.apta.com/resources/reportsandpublications/Documents/aging_stranded.pdf, accessed 3 November 2014

Banister, D. and D. Stead (2004) 'Impact of Information and communications technology on transport', Transport Reviews 24(5): 611-632

Banister, D., K. Anderton, D. Bonilla, M. Givoni and T. Schwanen (2011) 'Transportation and the environment', Annual review of Environment and Resources 36: 247-270

Banister, D. (2007) 'Cities, urban form and sprawl: A European perspective', in Transport, Urban Form and Economic Growth, ECMT Round Table 137, Paris: 113-142

Banister, D. (2011) 'Cities, mobilities and climate change', Journal of transport geography, JOURNAL OF TRANSPORT GEOGRAPHY, 11/2011, ISSN: 0966-6923, Volume 19, Issue 6, p. 1538

Boarnet, M. (2013) 'The transportation transformation of our cities will be more important than density changes!, Cityscape 9/1/2013, ISSN: 1936-007X, Volume 15, Issue 3, p. 175

Boschmann, E. and M.P. Kwan (2008) 'Toward socially sustainable urban transportation: Progress and potentials', International Journal of Sustainable Transportation 2(3): 138-157

BP plc (2014) BP Statistical Review of World Energy 2014 www.bp.com/content/dam/bp/pdf/Energy-economics/statistical-review-2014/BP-statistical-review-of-world-energy-2014-full-report.pdf

Buehler, R. and J. Pucher (2012) 'Demand and public transport in Germany and the USA: An analysis of rider characteristics' Transport Reviews 32(5): 541-567

Camagni, R. et al. (2002) 'Urban mobility and urban form: the social and environmental cists of different patterns of urban expansion', Ecological Economics, 2002, ISSN: 0921-8009, Volume 40, Issue 2, p. 199

Cervero, R. (1997) ' Paradigm shift: From automobility to accessibility planning', Urban Futures 22(1):9-20

Cervero, R. (2005) Accessible Cities and Regions: A Framework for Sustainable Transport and Urbanism in the 21st Century, Institute of Transportation Studies, Berkeley Center for Future Urban Transport, Working Paper, UCB-ITS-VWP-2005-3, Berkley, http://www.its.berkeley.edu/publications/UCB/2005/VWP/UCB-ITSVWP-2005-3.pdf

Charles, M.B. (2011) 'Transport energy futures: Exploring the geopolitical dimension', Futures, 2011, ISSN: 0016-3287, Volume 43, Issue 10, p. 1142

Cole, S. (2008) 'The Zeitgeist of Futures?', Futures, 2008, ISSN: 0016-3287, Volume 40, Issue 10, p. 894

Commission for Global Road Safety (2006) Make Roads Safe: A New Priority for Sustainable Development, Commission for Global Road Safety, London, http://www.makeroadssafe.org/publications/Documents/mrs_report_2007.pdf

Coughlin, J and C. Tompkins (2009) 'Demographics, Destiny, and Anticipating the Future of the Transportation System', Public Works Management & Policy, 4/2009, ISSN: 1087-724X, Volume 13, Issue 4, p. 284

Davis, B., T. Dutzik and P. Baxandall (2012) Transportation and the New Generation: Why Young People are Driving Less and What it Means for Transportation Policy, Frontier Group, Washington, DC

Deaking, E. et al. (2009) 'Intelligent Transportation Systems – Linking Technology and Transport policy to help steer the future' ACCESS, Number 34, Spring 2009

Demographia (2005) 'Greenhouse gas emissions per passenger mile public transport and personal mobility USA: 2005', http://www.demographia.com/db-ghg-carstr.pdf

Downs, A. (2004) Still Stuck in Traffic: Coping with Peak-Hour Traffic Congestion, Brookings Institution Press, Washington, DC

Dupuy, G (2011) Towards Sustainable Transport: The Challenge of Car Dependence, John Libbey Eurotext, Montrouge, France

EC (2006) Keeping Europe Moving: Sustainable Mobility for Our Continent, Midterm review of the European commission's 2001 Transport White Paper, COM (2006) 314 Final, Brussels, 22 June, http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2006:0314:FIN:EN:PDF

EC (2011) 'White paper: Roadmap to a single European transport area – Towards a competitive and resource efficient trans port system, COM(2011) 144 Final', Brussels, http://ec.europa.eu/transport/strategies/doc/2011_white_paper/white_paper_2011_i_full_en.pdf

Echenique, M.H., A.J. Hargreaves, G. Mitchell and A. Namdeo (2012) 'Growing cities sustainably: Does urban form really matter?', Journal of the American Planning Association 78(2): 121–137

Gakenheimer, R. (1999) 'Urban mobility in the developing world', Transportation Research Part A, 1999, ISSN: 0965-8564, Volume 33, Issue 7, p. 671

Goldman, T. and R. Gorham (2006) 'Sustainable urban transport: Four innovative directions', Technology in Society 28(1–2): 261–273

Goodwin, P. (2012) 'Peak Travel, Peak Car and the Future of Mobility: Evidence, Unresolved Issues, Policy Implications, and a Research Agenda' Discussion Paper No. 2012-13, OECD International Transport Forum, Paris

Fisher, J. (2010) 'Transportation Modes and Challenges to Sustainability – A historical perspective', ITE JOURNAL-INSTITUTE OF TRANSPORTATION ENGINEERS, 3/2010, ISSN: 0162-8178, Volume 80, Issue 3, p. 16

Hale, C. and P. Charles (2008) 'Visions for a sustainable transport future: A comparative analysis of transport planning approaches in Singapore, Vienna and Brisbane', Centre for Transport Strategy, University of Queensland, in report of the 31st Australasian Transport Research Forum: 17–37

Hall, P. (1996) Cities of Tomorrow: an Intellectual History of Urban Planning and Design in the Twentieth Century, Blackwell, Oxford, UK

Hanson, S. and G. Giuliano (2004) The Geography of Urban Transportation. Third Edition, the Guilford Press

Hook, W. (2006) 'Urban transportation and the Millennium Development Goals', Global Urban Development 2(1): 1–9

International Transport Forum (2014)
Road Safety Annual Report 2014

Institute for Mobility Research (2013) ‘The future of mobility – scenarios for the United States in 2030’

Kenworthy, J. and F.B. Laube (1999): ‘Patterns of automobile dependence in cities: an international overview of key physical and economic dimensions with some implications for urban policy’, Transportation Research Part A, 1999, ISSN: 0965-8564, Volume 33, Issue 7, p. 691

Kenworthy, J. and T.J Lyons (2003) ‘Understanding and predicting private motorised urban mobility’ Transportation Research Part D, 2003, ISSN: 1361-9209, Volume 8, Issue 4, p. 267

Litman, T. (2006) ‘Changing Travel Demand: Implications for Transport Planning’, ITE JOURNAL-INSTITUTE OF TRANSPORTATION ENGINEERS, 9/2006, ISSN: 0162-8178, Volume 76, Issue 9, p. 27

Litman, T. (2013) ‘The Future Isn’t What It Used To Be – Changing trends and their implications for transport Planning’
Victoria Transport Policy Insitute, 12 March 2013

Martin, E. and S. Shaheen (2011) ‘The impact of carsharing on household vehicle ownership’, Access 38: 22–27,
http://www.uctc.net/access/38/access38_carsharing_ownership.pdf

Meyer, J., J. Kain and M. Wohö (1965) The Urban Transportation Problem, Harvard University Press, Cambridge

Millard-Ball, A. and L. Schipper (2010) ‘Are we reaching peak travel? Trends in passenger trans port in eight industrialized countries’, Transport Reviews 31(3): 357–378

Mitchell, W.J. (2010) Reinventing the automobile : personal urban mobility for the 21st century, Published: Cambridge, Mass. : Massachusetts Institute of Technology, c2010.

Moriarty, P. and D. Honnery (2008) ‘Low-mobility: The future of transport’, Futures, 2008, ISSN: 0016-3287, Volume 40, Issue 10, p. 865

Nakicenovic, N. (1986) ‘The automobile road to technological change’, Technological Forecasting and Social Change 29:309–340

Newman, P. and J. Kenworthy (1999) Cities and Automobile Dependence: An International Sourcebook, Gower, Aldershot, UK

Newman, P. and J. Kenworthy (2011b) ‘Peak car use: Understanding the demise of automobile dependence’, World Transport Policy and Practice 17(2): 31–42

Nunen, E. van. et al. (2012) ‘Cooperative Competition for Future Mobility’, IEEE Transactions on Intelligent Transportation Systems, 2012, ISSN: 1524-9050, Volume 13, Issue 3, p. 1018

Poczter, S and L. Jankovic (2014) ‘The Google Car: Driving Toward A Better Future?’ Journal of business case studies, 2014, ISSN: 1555-3353, Volume 10, Issue 1, p. 7

Replogle, M. and M. Kodransky (2010) ‘Bridging the urban transport divide in the US and Europe’, unpublished paper presented at Urban Researchers Roundtable: Bridging the Urban Transport Divide, UN-Habitat Meeting, Rio de Janeiro, March

Richards, B. (2001) Future Transport in Cities, Spon Press

Romm, J. (2006) ‘The car and fuel of the future’, Energy Policy, 2006, ISSN: 0301-4215, Volume 34, Issue 17, p. 2609

Row, S. (2013) ‘The Future of Transportation’, Institute of Transportation Engineers. ITE Journal, 10/1/2013, ISSN: 0162-8178, Volume 83, Issue 10, p. 24

Santos, A. et al. (2011) “Summary of Travel Trends: 2009 National Household Travel Survey”

Schafer, A. and D.G. Victor (2000) ‘The future mobility of the world population’, Transportation Research Part A, 2000, ISSN: 0965-8564, Volume 34, Issue 3, p. 171

Schafer, A. (1998) ‘The global demand for motorized mobility’, Transportation Research Part A, 1998, ISSN: 0965-8564, Volume 32, Issue 6, p. 455

Schoettle, B. and M. Sivak (2014) ‘A survey of public opinion about autonomous and self-driving vehicles in the US, the UK, and Australia’

Sclar, E. et al. (2014) Urban access for the 21st century : finance and governance models for transport infrastructure, Abingdon, Oxon; New York, NY: Routledge, 2014.

Seifert, W. (1968) ‘The Status of Transportation’, Proceedings of the IEEE, 1968, ISSN: 0018-9219, Volume 56, Issue 4, p. 385

Singer, A. (2013) Why we drive: The past, present and future of automobiles in America, Microcosm Publishing

Shell Passenger Car Scenarios up to 2030: Facts, Trends and Options for Sustainable Auto-Mobility

Shergold, I. (2010) ‘Operationalising ‘sustainable mobility’: the case of transport policy for older citizens in rural areas’, Journal of Transport Geography, 2010, ISSN: 0966-6923, Volume 18, Issue 2, p. 336

Stevenson, T. (2008) 'Imagining the future: Ideas for change', Futures, 2008, ISSN: 0016-3287, Volume 40, Issue 10, p. 915

Tight, M. (2011) 'Visions for a walking and cycling focused urban transport system', JOURNAL OF TRANSPORT GEOGRAPHY, 11/2011, ISSN: 0966-6923, Volume 19, Issue 6, p. 1580

TransitCenter (2014) 'Who's on Board? Mobility Attitudes Survey 2014', New York NY,
http://transitcenter.org/wp-content/uploads/2014/08/WhosOnBoard2014-ForWeb.pdf

Turton, H. (2006) 'Sustainable global automobile transport in the 21st century: An integrated scenario analysis', Technological forecasting & social change, 2006, ISSN: 0040-1625, Volume 73, Issue 6, p. 607

UN Habitat (2013) Planning and Design for Sustainable Urban Mobility: Policy Directions. Global Report on Human Settlement 2013, published by Routledge

Vergragt, P.J. (2007) 'Sustainable Mobility: from technological innovation to societal learning', Journal of Cleaner Production, 2007, ISSN: 0959-6526, Volume 15, Issue 11, p. 1104

World Bank (2002) Cities on the Move: A World Bank Urban Transport Strategy Review, World Bank, Washington, DC,
http://siteresources.worldbank.org/INTURBANTRANSPORT/Resources/cities_on_the_move.pdf

Electronic Resources:

'The Future of Driving: Seeing the back of the car' in the Economist (9/22/2012)
http://www.economist.com/node/21563280
(last accessed, 11/4/2014)

'America's newest hipster hot spot: The suburbs?' by Joal Kotkin (10/9/2014)
http://www.newgeography.com/content/004558-america-s-newest-hipster-hot-spot-suburbs
(last accessed, 11/4/2014)

"Yet more evidence of peak car – Not only do we now own fewer cars. We're also driving each of them less" by Emily Badger (7/23/2013)
http://www.citylab.com/commute/2013/07/yet-more-evidence-peak-car/6299/
(last accessed, 11/4/2014)

‘Skipping the drive: Fueling the telecommunication trend’ by Joel Kotkin (8/18/2008)
http://www.newgeography.com/content/00180-skipping-drive-fueling-telecommuting-trend
(last accessed, 11/4/2014)

“Why are Americans so suspicious of self-driving cars? by Alexis C. Madrigal (8/5/2014)
http://www.citylab.com/commute/2014/08/why-are-americans-so-suspicious-of-self-driving-cars/375596/
(last accessed, 11/4/2014)

“Millennials love transit most, boomers still stuck on cars” by Sarah Goodyear (9/18/2014)
http://www.citylab.com/commute/2014/09/new-study-millennials-love-transit-most-boomers-still-stuck-on-cars/380380/
(last accessed, 11/4/2014)

“How car companies are trying to win back millennials” by David Zax (9/2/2014)
http://www.citylab.com/design/2014/09/how-car-companies-are-trying-to-make-car-ownership-attractive-to-millennials/379377/
(last accessed, 11/4/2014)

“Aging America: The U.S. Cities going gray the fastest” by Joal Kotkin and Wendell Cox (10/31/2014)
http://www.newgeography.com/content/004757-aging-america-the-us-cities-going-gray-the-fastest
(last accessed, 11/4/2014)

“Cost of Traffic Congestion – Numbers twist the data” by Joe Cortright (10/20/2014)
http://nextcity.org/daily/entry/cost-of-traffic-congestion-numbers-twist-the-data-in-annual-prank
(last accessed, 11/4/2014)

“Millenials are in motion, but not necessarily by car” by Todd Litman (10/16/2014)
http://www.planetizen.com/node/71691
(last accessed, 11/4/2014)

APPENDIX:

Annual Report Analysis:
Annual Reports 2013:

BMW, 2014:
http://www.bmwgroup.com/e/0_0_www_bmwgroup_com/investor_relations/finanzberichte/geschaeftsberichte/2013/_pdf/report2013.pdf
(accessed: 02/26/2015)

Daimler, 2014:
http://www.daimler.com/Projects/c2c/channel/documents/2432177_Daimler_2013_Annual_Report.pdf
(accessed: 02/26/2015)

Ford, 2014:
http://corporate.ford.com/doc/sr13-form-10-k.pdf
(accessed: 02/26/2015)

GM, 2014:
http://www.gm.com/annualreport/downloads/2013_GM_Annual_Report.pdf
(accessed: 02/26/2015)

Honda, 2014:
http://world.honda.com/investors/library/annual_report/2013/honda2013ar-all-e.pdf
(accessed: 02/26/2015)

Nissan, 2014:
http://www.nissan-global.com/EN/DOCUMENT/PDF/AR/2013/AR2013_E_All.pdf
(accessed: 02/26/2015)

Peugeot, 2014:
http://psa.publispeak.com/sustainable-development-and-annual-report-2013/com/ipedis/publispeak/client/contents/pdf/Sustainable_development_and_annual_report_2013.pdf
(accessed: 02/26/2015)

Toyota, 2014:
http://www.toyota-global.com/investors/ir_library/annual/pdf/2013/ar13_e.pdf
(accessed: 02/26/2015)

Volvo, 2014:
http://www.volvocars.com/SiteCollectionDocuments/TopNavigation/Corporate/Financials/VOLVO_CARS_13_Eng.pdf

(accessed: 02/26/2015)

VW, 2014:
http://www.volkswagenag.com/content/vwcorp/info_center/en/publications/2014/03/Y_2013_e.bin.html/binarystorageitem/file/GB+2013_e.pdf
(accessed: 02/26/2015)

Annual Reports 2005:

BMW, 2006:
http://www.bmwgroup.com/publikationen/e/2005/pdf/gb2005_gesamt_en.pdf
(accessed: 03/06/2015)

DaimlerChrysler, 2006:
http://www.daimler.com/Projects/c2c/channel/documents/1364375_2005_DaimlerChrysler_Annual_Report.pdf
(accessed: 03/06/2015)

Ford, 2006:
http://ophelia.sdsu.edu:8080/ford/12-30-2012/doc/2005_AR_full.pdf
(accessed: 03/06/2015)

GM, 2006:
https://www.mlcguctrust.com/Document-Download.aspx?Document=3
(accessed: 03/06/2015)

Honda, 2006:
http://dept.sfcollege.edu/business/susan.crosson/Spring%202006/080annualreports/2021-002/BEG%20Honda/BEGHonda.ppt
(accessed: 03/06/2015)

Nissan, 2006:
http://www.nissan-global.com/EN/DOCUMENT/PDF/AR/2004/ar2004e.pdf
(accessed: 03/06/2015)

Peugeot, 2006:
http://www.zonebourse.com/PEUGEOT-4682/pdf/4947/PEUGEOT_Rapport-annuel.pdf
(accessed: 03/06/2015)

Toyota-Boshoku, 2006:
http://www.toyota-boshoku.com/common/global/pdf/Annual_Report_2005.pdf
(accessed: 03/06/2015)

Volvo, 2006:
http://www3.volvo.com/investors/finrep/ar05/annual_report_2005_eng.pdf
(accessed: 03/06/2015)

VW, 2006:
http://www.volkswagenag.com/content/vwcorp/info_center/en/publications/2005/03/annual_report_2004.bin.html/binarystorageitem/file/Gbericht_2004_en.pdf
(accessed: 03/06/2015)

Media and External Communication analysis:

BMW:
http://www.bmwgroup.com/bmwgroup_prod/e/0_0_www_bmwgroup_com/forschung_entwicklung/mobilitaet_der_zukunft/project_i/project_i.html
(accessed: 03/09/2015)

http://www.bmwgroup.com/bmwgroup_prod/e/0_0_www_bmwgroup_com/forschung_entwicklung/mobilitaet_der_zukunft/verkehrsmanagement/verkehrsmanagement.html
(accessed: 03/09/2015)

Daimler:
Livestream: “The future of mobility: No emissions, no accidents, no drivers?” – Talk by Dr. Dieter Zetsche at Oxford University
http://new.livestream.com/oxuni/mercedes
(accessed: 03/09/2015)

http://www.daimler.com/dccom/0-5-1742887-1-1743293-1-0-0-1743248-0-0-135-0-0-0-0-0-0-0-0.html
(accessed: 03/09/2015)

Ford:
http://corporate.ford.com/microsites/sustainability-report-2013-14/financial-mobility-blueprint.html
(accessed: 03/09/2015)

GM:
http://media.gm.com/autoshows/Shanghai/2010/public/cn/en/env/news.detail.html/content/Pages/news/cn/en/2010/March/env01.html
(accessed: 03/09/2015)

Honda:
http://corporate.honda.com/innovation/
(accessed: 03/09/2015)

http://corporate.honda.com/innovation/walk-assist/
(accessed: 03/09/2015)

http://corporate.honda.com/innovation/asimo.aspx
(accessed: 03/09/2015)

Nissan:
http://nissannews.com/en-US/nissan/usa/releases/nissan-inspired-by-bees-and-fish-in-developing-technology-for-future-mobility
(accessed: 03/09/2015)

Peugeot:
http://www.psa-peugeot-citroen.com/en/inside-our-industrial-environment/a-socially-responsible-business/setting-the-standard-in-sustainable-mobility-article
(accessed: 03/09/2015)

Toyota:
http://www.toyota-global.com/innovation/intelligent_transport_systems/
(accessed: 03/09/2015)

Volvo:
http://www.motorauthority.com/news/1088831_volvo-launches-latest-autonomous-cars-pilot-in-sweden
(accessed: 03/09/2015)

VW:
http://www.volkswagenag.com/content/vwcorp/content/en/innovation/future_and_mobility.html
(accessed: 03/09/2015)

http://www.volkswagenag.com/content/vwcorp/content/en/innovation/future_and_mobility/future_research_and_trend_transfer.html
(accessed: 03/09/2015)