Future of Automotive Industry – Outlook until 2025 in the framework of 13 automotive Megatrends.

A Master's Thesis submitted for the degree of
"Master of Business Administration"

supervised by

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I would like thank Dr.-Ing., Assoc.Prof. Ján Lešinský for his wisdom, knowledge, patience and supportive cooperation and making this academic work possible.

I would like to dedicate this work to my wife, my daughter and son, my parents, my brother and sister for their support and patience during the MBA program.

Affidavit

I, **MATTHIAS ZACHARNIK**, hereby declare

1. that I am the sole author of the present Master's Thesis, "FUTURE OF AUTOMOTIVE INDUSTRY – OUTLOOK UNTIL 2025 IN THE FRAMEWORK OF 13 AUTOMOTIVE MEGATRENDS", 71 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
2. that I have not prior to this date submitted this Master's Thesis as an examination paper in any form in Austria or abroad.

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Abstract

Circulation of tons of studies over the automotive future in respect of economical, ecological, sociological, technical and political perspective foresee a variety of new mobile worlds – but the consolidation of these studies is still lacking. What are the Megatrends in the Automotive Industry, what are the outlooks, what trends can be identified, what do we learn?

1. What Megatrends are apparent, how do these Megatrends look like, what are the implications on the Automotive Industry?
2. Automotive industry nowadays faces heavy economic and ecological turmoil – overcapacities in Europe, environmental crisis in Asia, rise of energy-prices over the world contribute to an automotive industry that faces menacing indicators for drastic change ahead. Is there a way out?
3. What are the actual countermeasures and activities shown by the industry?
4. What suggestions can be retrieved out of the Megatrends?

Content

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1. Introduction

To find the correct answer to the question of how the Automotive Industry is going to look like in 10-20 years is challenging.

This Master Thesis approaches the question by different perspectives, including socio-demographic, technical and economic development forecasts.

The common understanding of all experts, consultants and speakers, I talked to, can be abstracted to: “We can´t go on like we have done in the last 100 years – there has to be a change!”

The first insight into this subject started with a study from the Austrian traffic club VCÖ referring to the potential of car-sharing- systems in Vienna that would sweep away privately owned cars from the streets of Vienna. Interestingly the hesitation to car-sharing systems is an Austrian speciality, worldwide people are welcoming car-sharing systems. Austria, traditionally slow on innovative ideas, is behind that trend. Looking over the borders to our Swiss neighbours shows that people have embraced car-sharing 10 times stronger than Austrians, by the present time. But one thing can be said for sure – Austria is catching up.

The next interesting information is coming in from the U.S., indicating that less and less young people are willing to go through the driving school, decreasing numbers of young people are holding a driving licence. This phenomenon can be seen throughout the developed world – the importance of motorized individual mobility is decreasing continuously- in some countries the cutback is even accelerating.

The book of Dr. Patrick Dixon [1], a futurist and consultant and Chairman of the trends forecasting company Global Change Ltd. is eye-opening He claimes that either we take hold of our future, or the future will take hold of us. It is decisive to put down the glasses of deceit that each and every person is wearing. That would bring along quite a heavy load of confusion, but after the fog has set it would uncover a totally new perspective of the future. This master thesis is aiming at clearing the fog of uncertainty and trying to show a way how the future of the Automotive industry will look like in the next two decades.

2. Thirteen Automotive Megatrends

The global recession is accelerating the change within the automotive industry landscape. The industry is recovering slowly, the recession isn´t over yet, this mainly counts for Europe.

Looking at the BRIC states (Brasil, Russia, China, India) the situation is ambivalent. On the one hand the growing economic wealth is considerable (e.g. increasing GDP for first half of 2013 in China 7.7 %). On the other hand the BRIC states, especially China and India, are experiencing major effects of individual mobility. Health threatening air pollution, traffic jams beyond any european consideration, accident-statistics worse than the year 1972 in the western hemisphere (1972 is the year that was unique in Western Europe – never before and never after in history we experienced more deaths on the streets). [2]

Automotive Industry is at a turning point, and it is not obvious in which direction the industry is heading.

Today the industry is focusing on the following aspects:

- profitable and sustainable growth
- financial and operational flexibility
- investments in new technologies
- seizing opportunities in high-growth markets

But it is astonishing that only few companies are actively taking a grip on business opportunities beyond the era of mass-mobilization - the era of sustainable mobilization.

Five cruzial questions for automotive to prepare for the next decades

1. How will demand for vehicles and mobility evolve?
2. How will business models need to adapt?
3. What are the new market dynamics?
4. How will products need to adapt?
5. What are the supply/value chain issues and implications?

Anticipating the possible ways, automakers could answer these questions, those answers led the author to identify thirteen mega trends shaping the industry over the next decades. Knowing more about these mega trends can help to understand how the business can leverage opportunities in the industry.

The thirteen Megatrends

1. Travel Time Budget (TTB) and Travel Money Budget (TMB) are constant: The money and time spent by people on travelling is a constant and over decades non-changing figure – implying that approach of people to the automobile will develop after certain rules.
2. Growing number of Megacities: In majority people in 2025 are living in Megacities, by 2025 2/3rd of the world population is doing so. What does that mean for the automotive industry? Will demand for individual transport climb or fall?
3. Governments push for safer and cleaner environment: Green ideas are winning incrementally – governments are confronted with increasing health costs due to increasing numbers of illness and death due to pollution of air.
4. OEM´s develop new value proposition to meet shifting mobility needs: The industry reacts to the change lying ahead – and industry reacts partially excellent. Majority reacts badly and too late.
5. Change of intra-urban mobility: People in cities are mobile – but modes of mobility are changing rapidly.

6. Electrification of powertrains: Electrification isn´t a trend, it is the future.
7. New players take the lead in the mobility market: What happens if other than the traditional OEM´s are heading for the automotive industry – in giant leaps – as for example Google?
8. Collaboration among industry stakeholders: Industry´s collaboration practiques are changing – outsourcing of former key-elements is no longer a tabu.
9. Portfolio rationalization among the OEM´s: What type of cars will be bought in 2025? The trend is clear – lowcost-hightech is the credo.
10. Globalization of the industry: China is currently at the controls, investing much, learning fast. And there is a clear rolemodel for China – Japan.
11. New strategies for TIER 2 and TIER 3 suppliers: The OEM´s are shifting risks and value creation downwards, learning from the crisis.
12. Sustainable urban transportation: Smarter cities concepts are growing in number and future impact. The concepts are heading for reducing traffic, traffic-jams, individual traffic.
13. Demographic development: Society is aging, that counts for Western Europe, but even more for Asia with Japan and China as major contributors to this development. The one-child-politics in China takes its toll. And furthermore a change of customer behavior can be detected – young people abolish individual traffic – the number of driving school students are falling, the average age of enrolling students is increasing.

1.1 Travel time budget and travel time money stay constant

How much will people move around in the distant future? Which modes of transport will they use? In which parts of the world will transport be most intense? Answers to these questions are critical to planning of long-lived transport infrastructures and to assessing the consequences of mobility, such as environmental pollution. These questions also lie at the center of efforts to estimate the size of future markets for transportation hardware and services. Here we describe a simple but radically new model, which we use to develop a scenario that offers plausible answers to these questions.

Travel time budget

On average, humans spend a fixed amount of their daily time budget traveling ± the travel time budget (TTB). Time-use and travel surveys from numerous cities and countries throughout the world suggest that TTB is approximately 1.1 h per person per day.[4]

The study by shows the stability of the travel time budget over a wide range of income levels, geographical and cultural settings: residents of African villages devote similar time for travel as those of Japan, Singapore, Western Europe or North America.[4]

Of course the TTB is different in very dense London and very wide Scotland. And studies have shown that TTB of economic more powerful individuals is generally lower than for less economic powerful individuals. But the stability of TTB in general is apparent. [4]

That means that any variation inflicting changes to the TTB would be answered by changing mobility habits aiming at a constant TTB.

The reason for the constant travel budget observed is not clear. It probably has to do with an inner sense of reason of the individuals, or, as cited by Schäfer [Schäfer et al.] stated: “Perhaps security of the home and family, the most durable unit of human organization, limits exposure to the risks of travel”. Although other time-consuming activities such as sleep, work and leisure may vary from country to country, the TTB remains constant. For example, compared with other OECD nations (France, Germany, UK, and US), Japanese workers spend 25% more time at work, yet travel time budgets are nearly identical.[4]

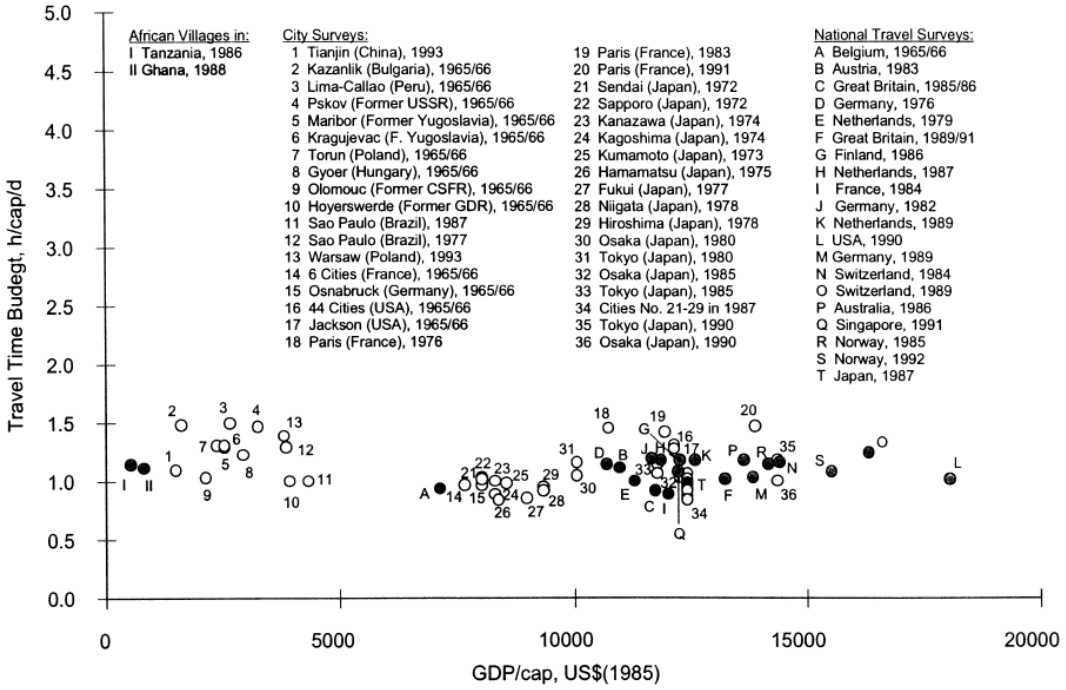


Fig.1: Travel Time Budget over GDP per capita, [4]

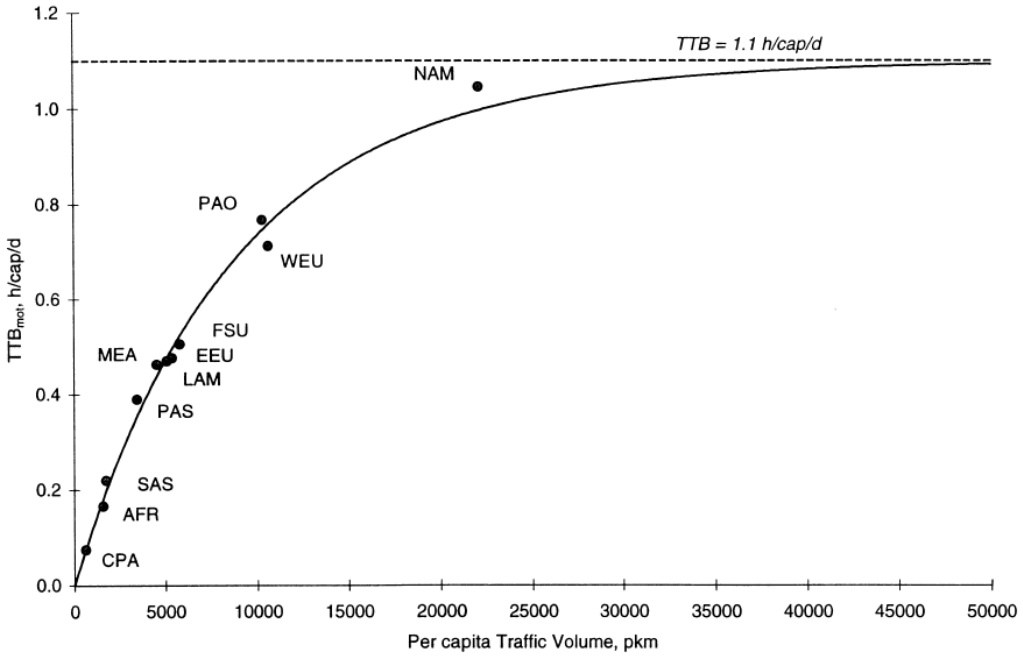


Fig.2: Travel Time Budget in h over the per capita traffic volume, [4]

Tab. 1: Abbreviations [4]

Industrialized Regions	
North America (NAM)	Canada, USA
Pacific OECD (PAO)	Australia, Japan, New Zealand
Western Europe (WEU)	European Community, Norway, Switzerland, Turkey
Reforming Regions	
Former Soviet Union (FSU)	Russia, Ukraine
Eastern Europe (EEU)	Bulgaria, Hungary, Czech and Slovak Republics,former Yugoslavia, Poland, Romania
Developing Regions	
Latin America (LAM)	Argentina, Brazil, Chile, Mexico, Venezuela
Middle East & North Africa (MEA)	Algeria, Gulf States, Egypt, Iran, Saudi Arabia
Sub-Saharan Africa (AFR)	Kenya, Nigeria, South Africa, Zimbabwe
Centrally Planned Asia (CPA)	China, Mongolia, Vietnam
South Asia (SAS)	Bangladesh, India, Pakistan
Other Pacific Asia (PAS)	Indonesia, Malaysia, Philippines, Singapore, South Korea, Taiwan, Thailand

Travel money budget

A second constant is that individuals devote a fixed proportion of income to traveling, the travel money budget (TMB). Fig. 3 presents TMB time series data for 13 industrialized countries and discrete points for three developing countries. TMB rises with the degree of motorization. Households without a personal car devote only 3±5% of income to traveling, which is illustrated by the three developing countries shown in Fig. 3. The rising TMBs for Greece, Japan, Italy and Portugal in Fig. 3 illustrates the effect of increasing motorization. With increased ownership of cars the TMB rises until it stabilizes at 10±15% when motorization rates exceed 200 cars per 1000 capita (e.g. 1980 in Italy). TMBs vary across countries with social and economic factors, such as the price level for travel services (high in Denmark and Portugal, lower in The Netherlands). However, within each society the TMB follows a predictable pattern.[4]

In the only exception, Japan, TMB has stabilized at only 7%, reflecting the atypically large share of public high-speed transport (e.g. Shinkansen) and higher prices for non-transport goods and services.[4]

Oil shocks in the 1970s, which overnight raised the cost of automobile transport, illustrate and test the stability of the travel money budget. The next figure shows seven transport-related indicators for the United States, the

country with the largest share of total mobility supplied by automobiles. In response to rising retail fuel prices (e.g. a 50% jump in 1979), travellers reduced other costs of transport, for example by demanding less expensive (and more fuel efficient) new vehicles. Despite these two rapid rises in fuel prices, multiple economic recessions, and fluctuations in new car prices, the travel money budget remained nearly unchanged between 1970 and 1990, oscillating between 7.9 and 9.0% of income (GDP/cap).[4]

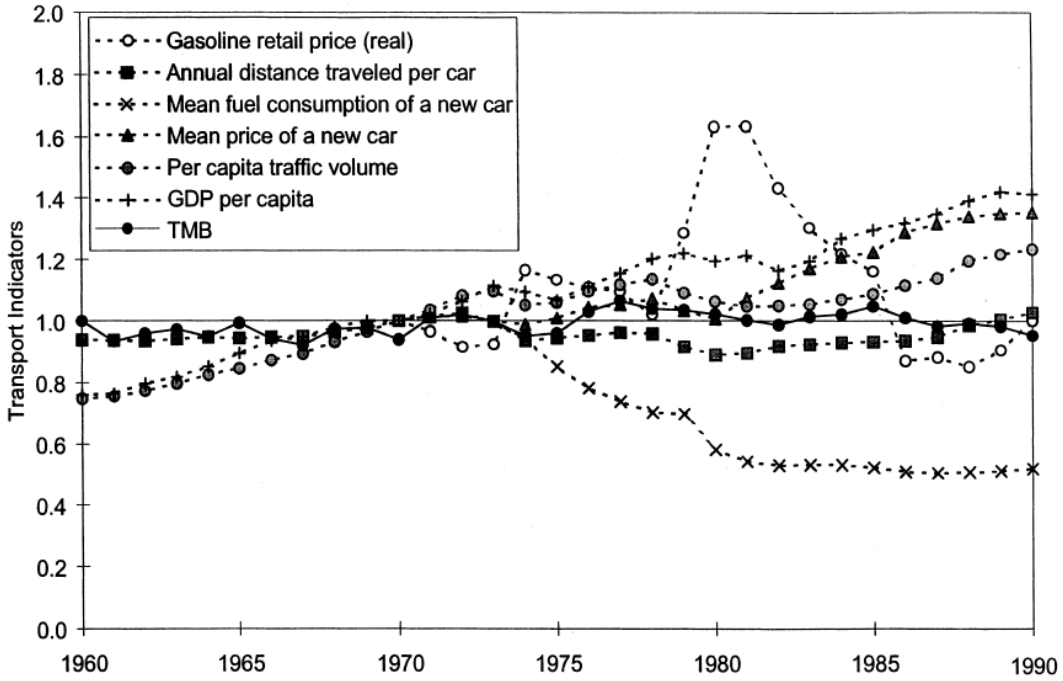


Fig. 3: TMB is stable over the period, despite two abrupt increases in real retail prices of automobile fuel. TMB remained level as consumers compensated by purchasing new cars with lower fuel consumption. [4]

By 2050, only the share of aircraft is growing; all other modes are in relative decline. Aircraft provide 36% of global mobility in 2050; automobiles supply 42%. In all three industrialized countries, automobile shares decline sharply by 2050. Rising automobility in developing countries is unable to offset fully the automobile's relative decline in other regions for several reasons:

- income levels remain low in AFR and CPA, and thus automobility remains modest in these regions

- higher population densities lead to a lower saturation level for automobiles
- high shares of air travel supplant some of the potential share of automobiles.

The following picture shows absolute mobility levels for each mode in 1960, 1990, 2020 and 2050. In light of the four fold rise in total mobility, the absolute mobility by each mode increases even for modes that are in relative decline. Absolute mobility by car increases 260%. High speed mobility rises to 28 times its 1990 level.

Such a strong increase in air travel may appear unrealistic because the airway network is already dense and congested in some regions. However, many technological possibilities are feasible and can easily ®nd widespread application within six decades. Aircraft can be bigger ± carriers with a capacity of 1000 people are technologically feasible before 2020 (e.g. Covert et al., 1992). In addition, our scenario for ``aircraft'' consists of all high-speed modes operating at an average speed of 600 km/h, which may include surface-bound high speed transport modes such as wheel-on-rail and magnetic levitation trains. Currently such trains provide a minor share (4%) of global high-speed mobility, but many plans are under way to build more extensive networks.

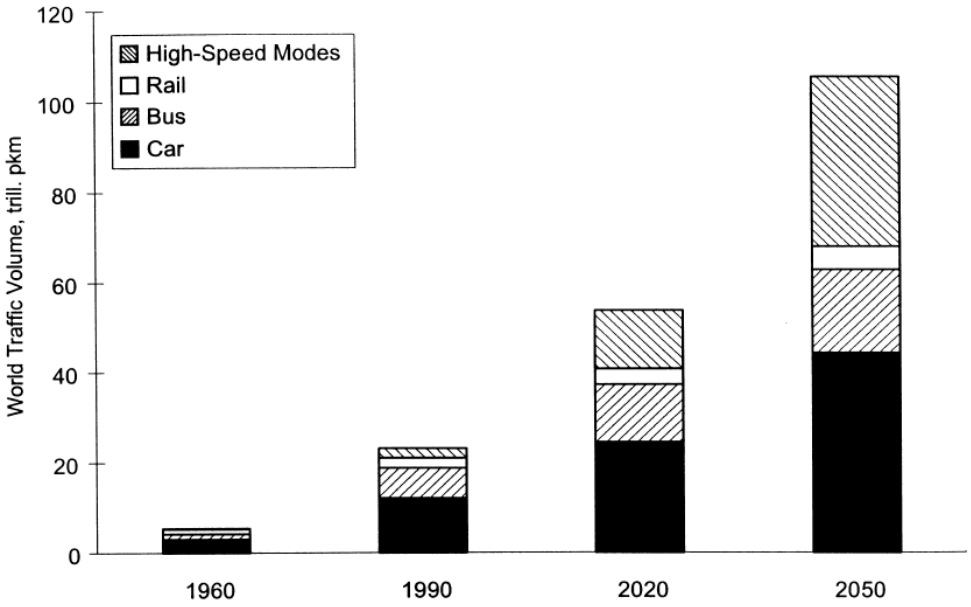


Fig.4: Historical and estimated future total global mobility by mode in 1960, 1990, 2020 and 2050. [4]

Since the share of traffic volume supplied by conventional railways and high speed transport modes have a uniform development in all 11 world regions, such a trend is also evident in the aggregated world projection. However, no such uniform trend is evident in the world automobile and bus scenarios, although clear trends are evident for those modes in most of the regions. Thus even if the aim of a transport scenario is only to estimate world mobility and modal shares, results from our method underscore that it is essential to build such scenarios on estimates for a number of coherent regions.

A consistent stepwise pattern ± slow modes are replaced by ever-faster ones.

At mobility levels below 5000±7000 passenger km per capita, low-speed public transport modes predominate. As the economy of each region grows, so does the travel demand; a greater distance must be covered within the same ®xed time budget and thus the share of faster automobiles rises. At approximately 10,000 pkm per capita, automobiles predominate. At still higher levels of mobility, the automobile share declines as faster modes of transport ± aircraft ± are needed to satisfy the rising demand for mobility within the ®xed travel time budget. This relative decline must lead to an

absolute decline in automobile traffic volume at a sufficiently high level of total mobility.

The next figure illustrates the rise and fall of per-capita automobile traffic volume in NAM, with absolute declines evident starting in 2010 at per capita automobile traffic volume of 22000 pkm/cap.

Despite the projected absolute decline of automobility in the OECD and the strong growth of air traffic, the automobile will still remain an essential mode of transport. In fact, travellers will continuously spend most of their travel time in the automobile.

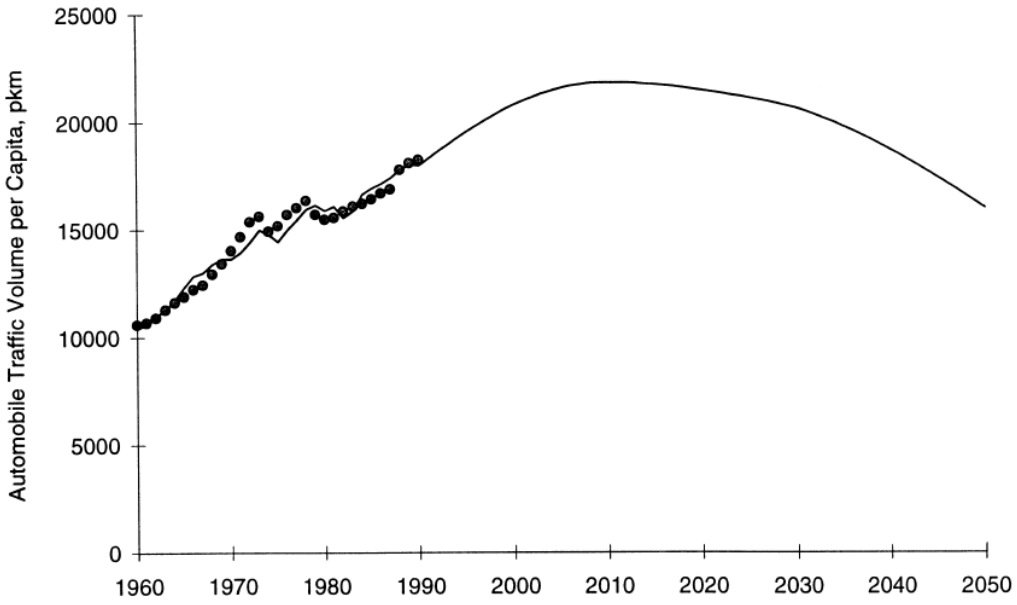


Fig. 5: Historical and projected per-capita automobile traffic volume in the NAM region, 1960±2050. [4]

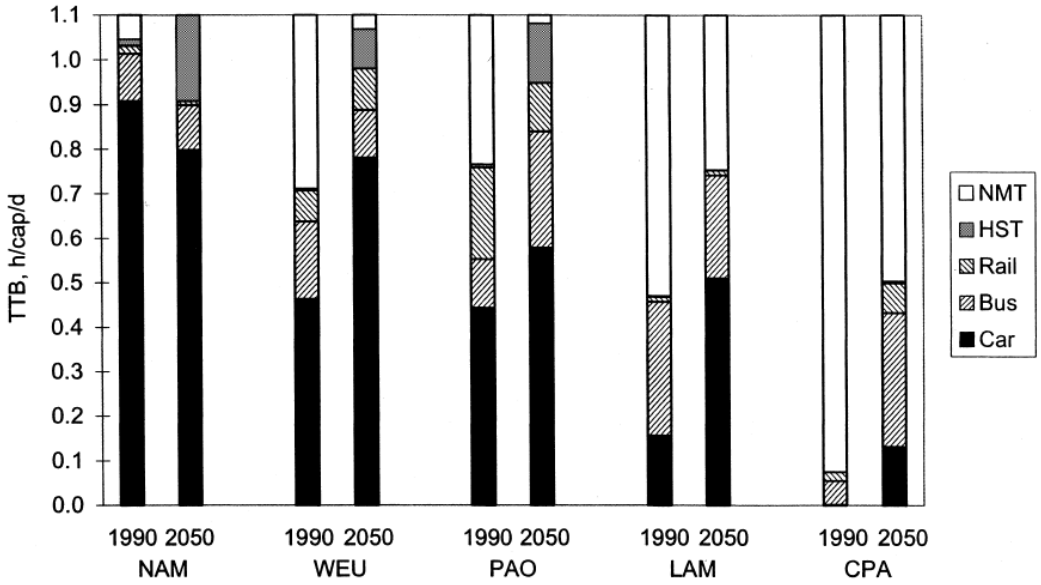


Fig. 6: TTB by mode of transport in 1990 and the results for 2050 in the three industrialized regions NAM North America, PAO Pacific OECD, WEU Western Europe, in LAM Latin America and one region from the developing world (CPA Centrally Planned Asia). Although automobility is projected to decline strongly in the industrialized regions, most of the travel time is still allocated for its use. NMT: non-motorized transportation; HST: high speed transportation. [4]

1.2 Growing number of Megacities

On average, a person spends about 70 minutes per day traveling [8]. This time budget is relatively constant over time and across countries. Consequently, wealthy people tend to travel faster and over longer distances.In the future there will be an overall increase in mobility throughout the world. For example, Schäfer and Victor (2000) projected that by 2050 the average citizen of the world will travel (by all modes) as much overall distance as the average Western European did in 1990.[8]

Correlation-factors on private vehicle usage

Private motorized daily trips is dependent on or influenced by :

- natural logarithm of urban population density
- natural logarithm of proportion of jobs in the central business district

- natural logarithm of parking spaces per thousand jobs in the central business district
- percentage of daily trips per foot or bike

It was found that natural logarithm of density, natural logarithm of proportion of jobs in the Central Business Districts CBD´s and daily trips on foot and by bicycle have negative relationship with private motorized daily trips.

That means that high populated areas have a very negative effect on private usage of cars.

On the other hand, the natural logarithm of parking spaces per thousand jobs in the CBD has a positive relationship. Among these predictors, natural logarithm of density has the highest negative coefficient.

Consequently, higher density, lower proportion of parking spaces in CBD, higher proportion of jobs in CBD and higher daily trips on foot and by bicycle can reduce private motorized daily trips.

Contradiction between future individual mobility and megacity trends

From 2000 to 2050, the all-mode-mobility of the average American will increase by a factor of 2.6, to 58,000 km/year [4]. Forecast show that the average Indian will increase his/her travel to 6,000 km/year by 2050, comparable to the level of West Europeans in the early 1970s. In total, in 2000, people traveled 23 billion km, and by 2050 that figure is expected to grow to 105 billion km [4]. At the same time, urban population continues to expand, and the number of megacities — cities with over 10 million inhabitants—is expected to double within a generation [4]. As cities grow and become richer, vehicle ownership and use tend to increase rapidly. This, in turn, has an influence on travel speed, congestion, and air pollution.

The above trends have resulted in wide discussion about sustainable transportation in metropolitan areas. In broad terms, movement to sustainable urban transportation involves accessibility and the generation of wealth by cost-effective and equitable means, while safeguarding health and minimizing the consumption of natural resources and the emission of pollutants [5]. Frequently, this has been feasible with wide use of public transportation in general, and rapid rail transportation in particular. For

example, there are cities such as Tokyo and Hong Kong that invested in public transport to provide extensive, high-quality, public transport systems before private vehicle ownership was high [5]. In these cities, bus travel was at a high level until rapid mass transit was built and became affordable.

However, personal vehicles are an integral part of modern city life, providing a number of benefits to individuals and society no matter how they are used—as single occupancy vehicles or as shared or shuttle vehicles. Consequently, as pointed out by Kennedy et al. (2005), planning for a new generation of sustainable personal vehicles is critical for the sustainable development of cities. Through technical innovation and the application of concepts of industrial ecology, there are several possible candidates for the sustainable personal vehicles of the future [5]. In addition, it is likely that many applications of intelligent transportation systems will substantially affect future urban transportation. These applications include, for example, demand management (demand-responsive public transportation, car pooling and sharing, access control, road-use charging), trip planning systems/real-time traveler information, and signal priorities for public transport. This study was designed to examine the future role of personal vehicles in megacities of the world. Of particular interest was whether there would likely be a change by 2025 from the current level of usage, and the variability of future usage across megacities and types of trips.

Demand for personal transportation is influenced by a variety of factors. Size of the population (for absolute demand) and wealth of the population (for both absolute demand and per population demand) play vital roles ([5]). Consequently, Figure 7 presents the expected growth in population of the examined megacities.

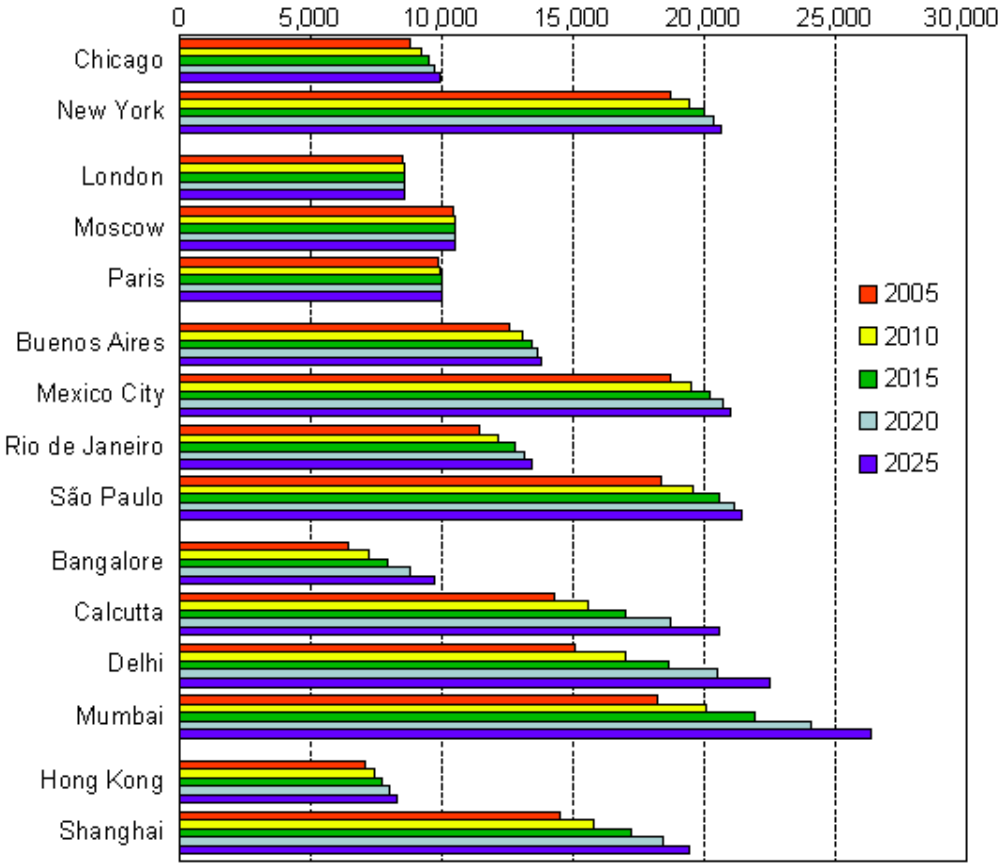


Fig 7: Population (in thousands) for examined metropolitan areas [2]

The results indicate that the highest proportional increases from 2005 to 2025 (more than 30%) is predicted for Bangalore, Calcutta, Delhi, Mumbai, and Shanghai, followed by modest increases (12-18%) for Chicago, Hong Kong, Mexico City, Rio de Janeiro, and São Paulo. The lowest increases (less than 12%) are predicted for Buenos Aires, London, Moscow, New York, and Paris. Overall, the highest increase of population will take place in the examined Indian and Chinese metropolitan areas. [2]

The number of private vehicles and motorcycles per thousand inhabitants by metropolitan area are shown in Figure 2. The highest ownership of private vehicles is in the North American metropolitan areas, followed by the European and Central/South American metropolitan areas, while it is substantially lower in the Indian and Chinese metropolitan areas. However, motorcycle ownership in the Indian metropolitan areas is high. [2]

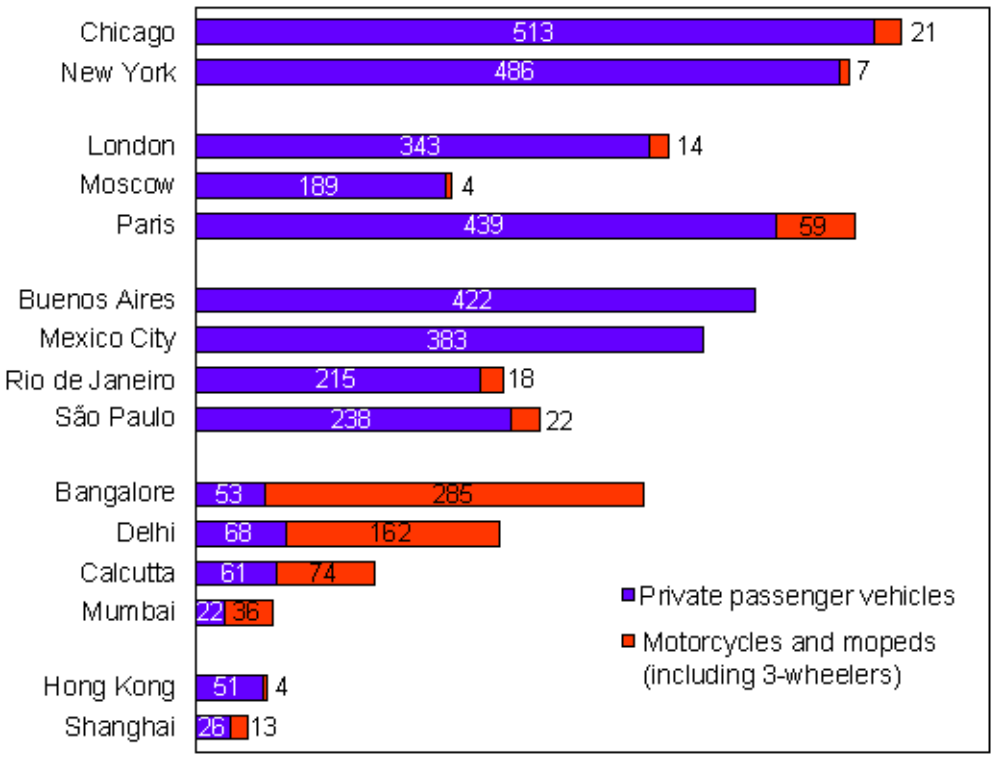


Fig 8: Private passenger vehicles (4-wheelers) and motorcycles (2- and 3-wheelers) per thousand inhabitants. [2]

Changes in Megacities-Mobility up to 2015

Tab 2: Likely changes in personal transportation in metropolitan areas by 2025.
+++ = substantial increase, ++ = moderate increase, + = minor increase, ± = no change, - = decrease. [2]

Metropolitan area	Personal vehicle ownership per capita	Distance traveled per capita by personal vehicles			Number of road fatalities per capita
		Inner core	Commuting	Leisure	
Chicago	±	±	± or -	± or -	-
New York	±	±	± or -	± or -	-
London	±	±	± or -	± or -	-
Moscow	++	+	±	++	++
Paris	±	±	± or -	± or -	-
Buenos Aires	± or +	±	±	+	+
Mexico City	± or +	±	±	+	+
Rio de Janeiro	++	±	±	++	++
São Paulo	++	±	±	++	++
Bangalore	+++	±	±	++	++
Calcutta	+++	±	±	++	++
Delhi	+++	±	±	++	++
Mumbai	+++	±	±	++	++
Hong Kong	+	±	±	+	+
Shanghai	+++	±	±	+++	+++

The current and future values of the following factors were considered: population, wealth, level of motorization, public transportation, and modal split. Also discussed were selected urban transportation plans and strategies.

Based on the analysis, projections through 2025 were made for each megacity for changes in ownership of personal vehicles; distance travelled per capita by personal vehicle within inner core, for commuting, and for leisure; and for number of road fatalities per capita. The forecasts include the following:

- The largest increases in personal vehicle ownership will occur in the four Indian megacities and Shanghai.
- There will be no increase in the use of personal vehicles for inner-core transportation in any of the megacities.
- No increases are expected in the use of personal vehicles for commuting.
- The largest increases in the use of personal vehicles for leisure traveling (and the largest increases in road fatalities) will take place in Shanghai, followed by the four megacities in India, Rio de Janeiro, and São Paulo.

Overall, no substantial decrease in the reliance on personal vehicles is foreseen in the next 15 years anywhere in the examined megacities. To the contrary, an increased role of personal vehicles is forecasted for the megacities in India, China, and Brazil.

The above trends are based on treating the different transportation modes as independent and exclusive options. However, there is growing implementation and use of new mobility networks—integrated networks that provide a variety of connected and IT-enhanced transportation options door-to-door. Although such networks are expected to reduce the reliance on personal vehicles, the magnitude and nature of this effect remain to be ascertained.

1.3 Governments push for safer and cleaner environment

Governments are focusing on three areas to secure individual mobility:

1. preservation of resources
2. environmental compatibility and
3. safety.

In response, original equipment manufacturers (OEM) will begin to build cleaner, safer and more diverse range of cars, including a variety of zero-emission vehicles.[20]

From the customer's perspective, penalties and incentives will influence their decision to own a vehicle and how it will be used. Penalties may include congestion and road user charging, and incentives, such as rebates, will be used to reduce the cost of ownership for zero-emission vehicles.

1.3.1 Legal regulations

Future regulations will be a key driver for automotive industry. Especially boundaries concerning CO2-emissions are regulating the market drastically up to the year 2025.

2025				
CO_2 limits	• 80 g/km average (39% cp. to 2015) • Binding segment specific limits	• 102 g/km (54,5mpg; -43% cp. to 2015) • Binding segment specific limits	• 112 g/km (-36% cp. to 2015) • Binding segment specific limits	• 130 g/km • Fleet average limit
Taxation / subsidies	• Moderate CO2-based tax • Tax exemptions for EV / PHEV1)		• Tax exemptions for EV / PHEV1) • Subsidies for EV in the basic segment	• Low CO2-based tax • No subsidies
E-only driving zones	• Some "e-only"-driving zones			• No "e-only"-driving zones

Fig. 9: Regulation Scenario´s 2025 [20]

Although the governmental restrictions are broadly executed all over the world, commonly understood steering-effects are moderate. The limits of 2025 can be reached with today´s technique, that's the good news.

The bad news is, that it is questionable, if the limits are as challenging as they could be. 12 years from now the regulative limits for individual traffic will have assumingly reached a level that can be technically fulfilled with today´s level of CE Combustion Engines development.

The study of AT Kearney is giving us a good overview over the future development of the regulation situation lying ahead 12 years.

Still there are some open questions that come unanswered with the study:

1. 12 years is, seen from the standpoint of political development, a very long period of time. We have no clue how the actual political

establishment is perpetuating its governmental power. Some facts are speaking of times very soon to come, changing the political system dramatically. More direct participation of the people would have drastic influence on political decisions to come.

2. The influential interactions between scientific and technological development and regulative actions yet have to be seen. It is very likely that regulative institutions are reacting very quickly to innovations, as seen in the execution of widespread catalytic converters 20 years ago.

Recent political activities in China to increase the number of green vehicles

China is forcing new-energy car promotions in 25 major cities. The officials are expecting a boost to the green automobile market after the country saw an overall deceleration in car sales partly due to last month's issuing of a tightened subsidy policy for fuel-efficient car models. [18]

The new-energy vehicle promotion is exempting new-energy cars from various restrictions on car purchases and map out new favorable policies, such as allowing lower parking fees, power prices and road tolls. [18]

When the new measures are in place, new-energy car buyers in cities such as Beijing, Shanghai, Guangzhou and Dalian may be offered free license plates, and will be exempt from license plate lottery and traffic restrictions.

In addition, the infrastructure for the use of new-energy cars will be largely improved. The pilot demonstration cities are required to build up sufficient electric charging posts at parking lots for the green cars. By the end of this year 2013, the State Grid will build up 75 charging stations as well as over 6,000 charging posts. The amount of charging stations is projected to surge to 400 by 2016 and 10,000 by 2020. [19]

1.4 OEM´s develop new value propositions

Consumers in the developed and developing world have different mobility needs. Continued urbanization is likely to lead consumers in the developed world to seek alternatives to car ownership even as it leads people in the developing world to buy more cars. Car-sharing and integrated mobility

businesses will become more popular in developed economies.

In the emerging markets, more people will be forced to buy cars simply for transportation, but infrastructure development will not keep up with the demand. In response, the OEMs will need to diversify their portfolios to offer more services (such as car-sharing schemes) and have a wider presence across all the different vehicle segments.

1.4.1 DAIMLER, BMW, Citroen

car2go is a car sharing provider of the German car manufacturer Daimler and the car rental company Europcar. It is offered in various inner cities of several countries. In Europe and North America car2go is used in 18 cities with 275,000 registered customers. [23]

650 of the 6,100 vehicles are equipped with battery-electric drives. In Germany, car2go operates in six cities with approximately 3,000 vehicles and over 70,000 registered users. In contrast to classic car rental, where customers rent cars at a fixed location and return it after one or more days, the new car-sharing models use vehicles inclusively free parking in urban areas with minute-exact calculation. The minute typically costs 29 cents, including fuel and parking fees. Direct competitors with the same concept for car2go in Germany are DriveNow (with a fleet of BMW and MINI vehicles) and Multi City (Citroën). After completion of two pilot projects, car2go since 2012 is in the implementation phase. The fleet consists of two-seaters, powered by electricity or internal combustion engines. The advantage is that smart fortwo microcar is a brand of Daimler.[23]

Unlike some other car-sharing programs, such as for Cambio Carsharing or city car, car2go-vehicles are not positioned at fixed rental stations, but freely distributed throughout the city. Customers can locate the nearest vehicle on the Internet via smartphone apps or via telephone hotline and spontaneously rent. Since it is an urban mobility concept for short term rentals at car2go, the billing is per minute and includes kilometers traveled, insurance, fuel and parking fees. Customers pay a registration fee, but otherwise, no deposit or monthly or annual membership fees.
Since the contract with the City of Dusseldorf in January 2012, there are car2go in 12 cities across North America and Europe. In Dusseldorf car2go shall first directly against competitors DriveNow on. [23]

Stadt	Land	Fahrzeuge	davon elektrisch	Start
Berlin	Deutschland	1200	16	Apr. 2012
Wien	Österreich	600		Dez. 2011
Hamburg	Deutschland	600		Apr. 2011
London	Vereinigtes Königreich	500		Dez. 2012
Vancouver	Kanada	400		Juni 2011
Stuttgart	Deutschland	400	400	Nov. 2012
Köln	Deutschland	350		Sep. 2012
Seattle	Vereinigte Staaten	330		Dez. 2012
Ulm	Deutschland	300	25	Mär. 2009
San Diego	Vereinigte Staaten	300	300	Nov. 2011
Düsseldorf	Deutschland	300		Feb. 2012
Calgary	Kanada	300		Juli 2012
Austin	Vereinigte Staaten	300		Mai 2010
Amsterdam	Niederlande	300	300	Nov. 2011
Toronto	Kanada	250		Juni 2012
Portland	Vereinigte Staaten	250		Mär. 2012
Birmingham	Vereinigtes Königreich	250		tba
Miami	Vereinigte Staaten	240		Juli 2012
Washington DC	Vereinigte Staaten	200		Mär. 2012
Lyon	Frankreich	ausgesetzt		Feb. 2012

Fig. 10: Car2Go in 12 Cities around the globe, numbers of cars [23]

Car2go launched in Berlin on 26 April 2012 with the first 1,000 cars. As of October 2012, the fleet was increased to 200 vehicles. The more than 25,000 customers that use the vehicles over 20,000 times in the week (November 2012). in 2013 to be 300 smart electric drive integrated in addition to the fleet, of which a few are in 2012 offered to rent station bound.

Further expansion of Car2Go

DFS (Daimler Financial Services) car2go expands further and takes over responsibility for moovel. For parking seekers, there are new deals. Mobility services are bundled into the future, Daimler Mobility Services GmbH.

Turnover of 100 million euros in 2014

"Especially in large citiest more and more customers seek flexibility - and we offer flexiility. It is estimated that the number of Carsharing users in Europe alone could rise to 15 million by 2020 from about 700,000 today.

Three car2go locations profitable

With car2go, Daimler has developed in a very short time the world's leading provider of flexible car-sharing models. Even the end of 2012 - significantly earlier than expected - the concept of the first three sites was profitable. The number of customers increased from 60,000 in late 2011 to 275,000 today. Until the end of 2013 there will be half a million. In Germany car2go is available in six cities with more than 100,000 customers and growing supplier of custom in the flexible car sharing segment. Worldwide car2go is currently present in 18 cities. In 2013 other cities are to be followed and the number of vehicles will be increased from 6,100 to over 10,000. Car2go already employs around 250 staff. Business-fleets are the target-group for the next years. While on the one hand, the fleet will be better utilized, on the other hand, employees can take advantage of available pool vehicles privately.

moovel is expanded

Moovel is the second car2go mobility concept, which was developed and piloted by Daimler Business Innovation. Moovel is a smartphone app, by which the customer is offered several options to go from A to B. Today mobility options as car2go mobility, taxi, carpool or public transportation can easily be compared one click with each other. In the future, the platform will be offered not only in numerous other cities, but the preferred mobility variants should be paid on moovel also.

Wide network of subsidiaries and partnerships

Daimler participates in a number of other mobility services, such as the provider of the smartphone app "myTaxi" as well as "carpooling.com" which is the German portal "mitfahrgelegenheit.de" market leader in this area. Addition, the Group is also involved in the inner-city courier "tiramizoo" and operates within the framework of the car2go car rental company Europcar, the respective municipalities and numerous providers of public transport together.

1.5 Change in intra-urban mobility

Currently, about 12,000 Austrians are Carsharing-users. Given a similar user-rate in Austria as we have in Switzerland, the number of car sharers in Austria would increase to nearly 120,000, 10 times of the rate today. Car sharing services, such as the recently launched autoshare.at and Denzel and Emil, belong the future. VCÖ expert Markus Gansterer: “Cars are operated just an hour a day. The other 23 hours it is mostly on public roads and consumes space, that´s about 95 percent of the day. Especially in the cities space is a very scarce good. Right now we encounter an increasing number of newly created space for car parking at the expense of space for people – whereas the global trends are going the other way round."

An average car is standing around 23 hours a day

In Austria's provincial capitals, in 2011 a total number of 1.18 million passenger cars were counted, up to 42,000 cars more than in 2007. With the exception of Vienna and Graz, in the provincial capitals the number of cars is growing faster than the population. Each additional car increases the space and congestion problems in urban areas. Carsharing brings great benefits.

A shared car replaces up to eight private cars

Carsharing is cheaper than owning a car if the annual mileage is less than 12,000 kilometers. The ownership of a compact car in addition to the actual high fuel costs of about € 6.000 per year for maintenance and depreciation is estimated. In comparison, the total cost of car sharing compact car will be annually only around 3,600 euros, with an average mileage of 6000 km.

Many forget that the fuel costs only take 10 to 15 percent of the total cost of a new car. Carsharing, charging the full cost per kilometer makes the advantages clearly comprehensible. Carsharing in Austria has a great growth potential, says the VCÖ. Currently, about 12,000 people across Austria use car sharing, including around 8,000 in Vienna.

The international comparison shows that in Austria car sharing has the potential to catch up to a swiss standards.

In Switzerland 100,000 car sharing users have reduced the number of privately owned cars by 20.000.

In Austria the switch from the private car to car sharing uncovers another dimension. 43 percent of Changers frequently ride by public transport, says the VCÖ. The trend in cities is clearly towards car use instead of ownership. Each additional offering that supports this trend and the private ownership of a car makes it unnecessary, is to be welcomed in our view.

Amount of cars increasing in the cities of Austria

Eisenstadt	9.694 Pkw (8.989)
Klagenfurt	56.056 Pkw (52.828)
St Pölten	29.143 Pkw (27.675)
Linz	96.835 Pkw (93.145)
Salzburg	73.484 Pkw (70.256)
Graz	123.348 Pkw (117.206)
Innsbruck	53.400 Pkw (51.341)
Bregenz	64.080 Pkw (60.051)
Vienna	674.526 Pkw (657.426)

Fig.11: Carnumbers 2011 compared to numbers in 2007, Statistik Austria, VCÖ 2012 [13]

Degree of motorization lowest in Vienna

Vienna	394
Innsbruck	445
Graz	472
Salzburg	496
Bregenz	505
Linz	511
St. Pölten	561
Klagenfurt	594
Eisenstadt	651

Fig.12: Number of cars per 1.000 inhabitants in Austria in 2011 Statistik Austria, VCÖ 2012 [13]

Switzerland is rolemodel in Carsharing

Car traffic in Vienna requires 8 times more space than cycling and even 60 times more space than walking. The parking requirements for the 674,500 cars with license plate corresponds to the Wiener space of 1,400 football fields. 24,056 cars were alone neuzugelassen since the beginning of the year in Vienna. A major problem for the traffic conditions in Vienna are the 350,000 cars who commute daily to Vienna. "In view of the rapidly growing population in the town square is an increasingly scarce resource. At the same time the valuable public space is decreasing.

80 percent of the public space is attributed to cars

While still 80 percent of the public space is attributed to cars, fewer people of Vienna are traveling by car. Only 29 percent of daily trips are handled in Vienna by car, while 34 percent are covered by bicycle or by foot. 40 percent of Vienna's households own a car. "A vote on the extension of parking management is not necessary. Now is the time to provide correspondingly more space to alternative transport modes.

Walking and cycling are the most efficient surface transport modes in the city – in respect of landuse, costs, speed and ecological standpoints . On the surface of a car parking space are ten bikes. A bike path can carry five times as many people as a car track of the same width. "Walking and cycling should not be pitted against each other. New bicycle infrastructure is therefore not to be put on cost of sidewalks.

Space requirement of the cars in Vienna

Fraction of the distance traveled daily routes	29 percent
Number of cars with Wiener	674,500
Footprint of this car	8.4 square kilometers (1,400 football fields)
Passenger car ownership	394 cars / 1,000 inhabitants
Car-free households	40 percent
Length of road network in Vienna	2800 km
Public parking space per car	7.8 m
Playground space per child	0.55 m

Fig.13: Space requirements of cars in Vienna, VCÖ Wien erlebt den größten Mobilitätswandel seit Massenmotorisierung [13]

1.6 Electrification of the Power Train – revolution on the roads

Electric vehicles are one of the most important ways to reduce motoring costs, reduce carbon use in transport, improve air quality and reduce global warming. Expect battery-powered vehicles to be 10% of the market by 2020. Models like Nissan's Leaf and Chevrolet's Volt have led the way.

Expect to see many rapid improvements in vehicle fuel efficiency using petrol and diesel, and many new ultra-efficient hybrid vehicles. Even if we only saw 30% energy saving in 30% of vehicle miles driven in developed nations over the next decade, we would save at least 9% in motoring energy use (at today's rate of miles driven a year). That would be the same as cutting today's global emissions by more than 1%.

JD Power Consultancy estimates that a third of emission cuts by 2020 will come from improving petrol and diesel engines, and 14% from miles driven in electric vehicles.

JD Power says Hybrids could save 80% fuel consumption

If all vehicles in America were hybrids, and half were plug-in hybrids (with large batteries), US imports of oil would fall by 8 million barrels a day or by 80% of daily consumption. Much of government economic stimulus packages for the auto industry have been linked to green tech, of which a huge proportion is things like battery technology.16 million new cars a year are sold in EU alone. If we assume that up to 25% of the smallest car market could be electric cars within 10 years, that would mean over 1 million sold each year, at an average cost of EUR 11,000,-. Electric car sales would then be worth at least EU11bn a year in the EU. [10]

At Kearney indicates in the Automotive study from 2012 that until 2025, almost 60% of all new cars in Europe will use an electrified powertrain with probably a focus on Plug-in-Hybrids (PHEV). [10]

Electric cars can produce much lower emissions than burning fuel in mobile engines, but it all depends on how the electricity is generated. Burning petrol or diesel in a small, mobile engine can be inefficient compared to the most efficient coal-fired power generators. When petrol is used to power a vehicle, only 15-20% of the energy is usually captured to drive the car forward, compared to 40% in making electricity in an efficient coal power station.

It is true that a small amount of power is lost between power station and battery, and 20% of electricity put into the car is lost in heat (batteries and other components). But even when we include these things, we can see that “coal-powered” electric cars are likely to be better users of fossil fuels than diesel or petrol vehicles.

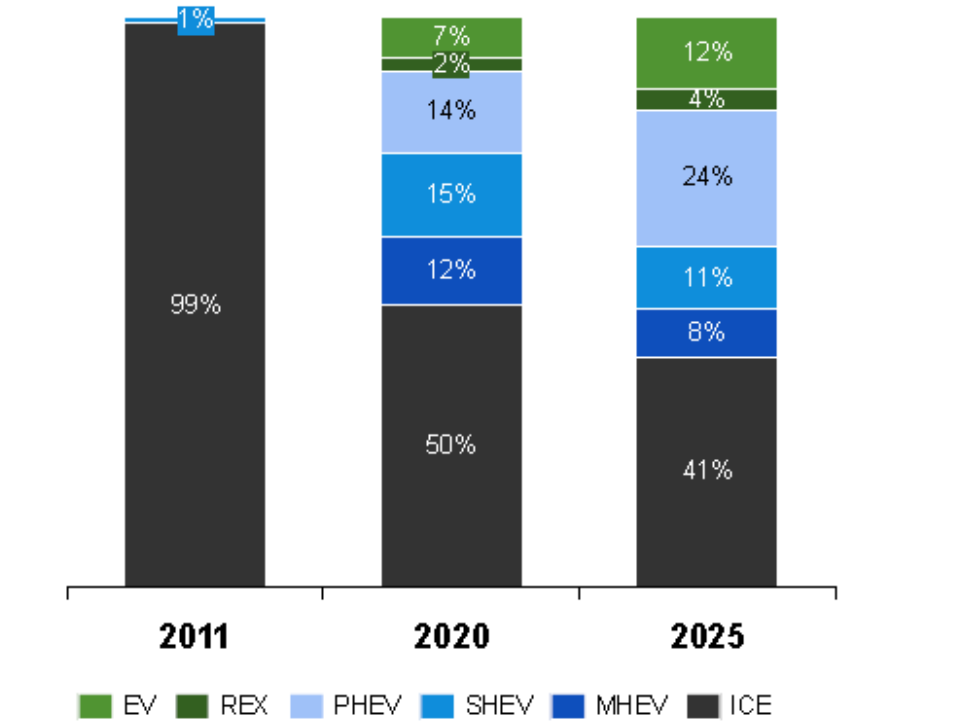
Where wind, solar, waves, tide or nuclear power is used to charge batteries, electric cars have zero emissions. Either way, air quality improves dramatically in cities as the use of electric vehicles increases. Owners can also save a huge amount of vehicle tax on petrol or diesel since taxation is far lower on electricity. It typically costs only 1-2 cents a mile in electricity. One thing is certain: if half a million people are driving electric cars across a nation, oil consumption will fall dramatically, while coal or gas power consumption will rise in the short term.

Batteries are going to be one of the biggest green tech businesses – powering not only phones and other small devices, but also cars, trucks, buses and just about any large piece of equipment that does not have a permanent electricity connection. Expect sales of hundreds of billions of dollars. President Obama's economic stimulus provided $2.4 billion to fund battery innovation and electric car drive projects.
Car batteries will have another purpose: linked together when charging at people's homes, to create Virtual Storage by power companies, to assist their power management at off peak times. This will make it easier for them to plug in huge numbers of wind and solar generators. Smart grids will allow power to flow in both directions, so that each battery can become a power source to other people in the neighbourhood for short periods of time. If 200,000 electric cars were plugged into the German national grid, it could make 8 megawatts of power available almost instantly, giving more flexibility than the nation currently needs.

AT Kearney says, that until 2025 ICE will decrease dramatically

- Internal Combustion Engine ICE: Significant decrease in market share remaining volumes mainly in cost sensitive smaller vehicle segments.
- Mild Hybrids MHEV: Peak probably before 2020, decrease in share with growing relevance of Strong Hybrids (SHEV) and Plug-in-Hybrids (PHEV)
- Strong Hybrids SVEV: peak around 2020, decrease in share with growing importance of PHEV
- Plug-In-Hybrids PHEV: Increases in importance towards 2020 and gains significant market shares towards 2025. Combines high customer benefits with low CO2 emissions especially for larger vehicles.
- Electric Vehicles EV/ Range Extenders REX: Moderate growth until 2020, especially in Basic and Compact Segments.

1.6.1.1 Powertrain Volumes worldwide up to 2025



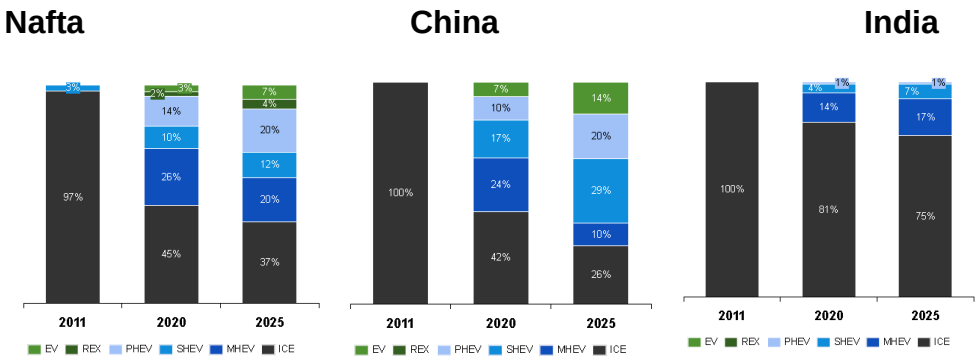


Fig.14: Powertrain volumes in global, Nafta, China, India in 2011, 2020 and 2025, [10]

1.6.2 Hydrogen and Fuel-Cells – answers to the battery problem?

Many people talk about the so-called hydrogen economy or water-powered cars. However, making hydrogen requires electricity to split water into hydrogen and oxygen, and in an area where most power comes from coal, these hydrogen cars are running on coal power. [1]

Hydrogen is also difficult to store and transport. It is a very “thin” gas which seeps through microscopic cracks, so gas can be lost when piped under pressure over long distances. Total energy per cubic litre (liquid hydrogen) is less than carbon-based liquid fuels, so tanks also have to be larger. Filling a normal sized fuel tank of 75 litres (20 US gallons) with hydrogen at room temperature and pressure will only take a car 1 kilometre. [10]

Hydrogen could be used in fuel cells, producing electricity at the same time as producing water from hydrogen and oxygen. Less heat is lost than burning hydrogen, but the costs are high. For all these reasons, it seems unlikely that tomorrow’s global auto industry is going to switch to hydrogen anytime soon. Meanwhile, fuel cell development is being rapidly overtaken by huge gains in battery power and efficiency.[10]

1.7 New players take the lead in the mobility market

New players will enter the market because of advances in technology and unmet consumer needs. Non-automotive companies are providing services such as car-sharing, mobility integration, usage-based “black-box” insurance that sets premiums based on real-time monitoring of driving performance, electric vehicle integration and advanced car entertainment systems.

The evolution of these new business models brings new entrants into the traditional automotive value chain, adding additional areas of risk and opportunity for OEMs in redefining their business focus.

1.7.1 Google Car

The Google driverless car is a project by Google that involves developing technology for driverless cars. The project is currently being led by Google engineer Sebastian Thrun, director of the Stanford Artificial Intelligence Laboratory and co-inventor of Google Street View. Thrun's team at Stanford created the robotic vehicle Stanley which won the 2005 DARPA Grand

Challenge and its US$2 million prize from the United States Department of Defense.

The U.S. state of Nevada passed a law on June 29, 2011 permitting the operation of driverless cars in Nevada. Google had been lobbying for driverless car laws. The Nevada law went into effect on March 1, 2012, and the Nevada Department of Motor Vehicles issued the first license for a self-driven car in May 2012. The license was issued to a Toyota Prius modified with Google's experimental driverless technology. As of April 2012, Florida became the second state to allow the testing of driverless cars on public roads. California became the third state to legalize the use of self-driven cars for testing purposes as of September 2012 when Governor Jerry Brown signed the bill into law at Google HQ in Mountain View.

While Google had no immediate plans to commercially develop the system, the company hopes to develop a business which would market the system and the data behind it to automobile manufacturers. An attorney for the California Department of Motor Vehicles raised concerns that "The technology is ahead of the law in many areas," citing state laws that "all presume to have a human being operating the vehicle".[2] According to *The New York Times*, policy makers and regulators have argued that new laws will be required if driverless vehicles are to become a reality because "the technology is now advancing so quickly that it is in danger of outstripping existing law, some of which dates back to the era of horse-drawn carriages".

Google lobbied for two bills that made Nevada the first state where driverless vehicles can be legally operated on public roads. The first bill is an amendment to an electric vehicle bill that provides for the licensing and testing of autonomous vehicles. The second bill will provide an exemption from the ban on distracted driving to permit occupants to send text messages while sitting behind the wheel. The two bills came to a vote before the Nevada state legislature’s session ended in June 2011. It has been speculated that Nevada was selected due to the Las Vegas Auto Show and the Consumer Electronics Show, and the high likelihood that Google will present the first commercially viable product at either or both of these events. Google executives, however, refused to state the precise reason they chose Nevada to be the maiden state for the driverless car.

Google's driverless test cars have about $150,000 in equipment including a $70,000 LIDAR (laser radar) system.

1.8 Collaboration among industry stakeholders

Technology innovations are triggering business changes. OEMs and Tier 1 suppliers are looking to collaborate more than before, not just within the industry, but also with technology companies and telecoms, as well. In particular, they will likely work together to draft standards for emerging technologies, such as common protocols for in-vehicle connectivity and a common battery charging infrastructure for electric cars.

Additionally, OEMs are more willing to share platforms with competitors and focusing on flexible production in order to decrease R&D cost, reduce risk and decrease time to market.

1.8.1 Offshoring R&D

India and China as established R&D offshore centers increasingly gain importance in the automotive industry.

- Daimler in 2011 opened a Global Advanced Design Center in Bejiing and plans further R&D centers in Bangalore and Pune, India
- Bosch employs 2,100 R&D employees in China and is planning two further development and testing centers.
- Suzuki has chosen India as global hub for the development of small cars.
- Magna Steyr opens an Engineering Center in Shanghai for up to 500 employees.
- Volkswagen JVs (FAW &VW Shanghai) are commonly developing e-vehicles in and for China.
- Toyota builds a new Engineering Center in China for developing engines and adjusting vehicles to the requirements for the Chinese market

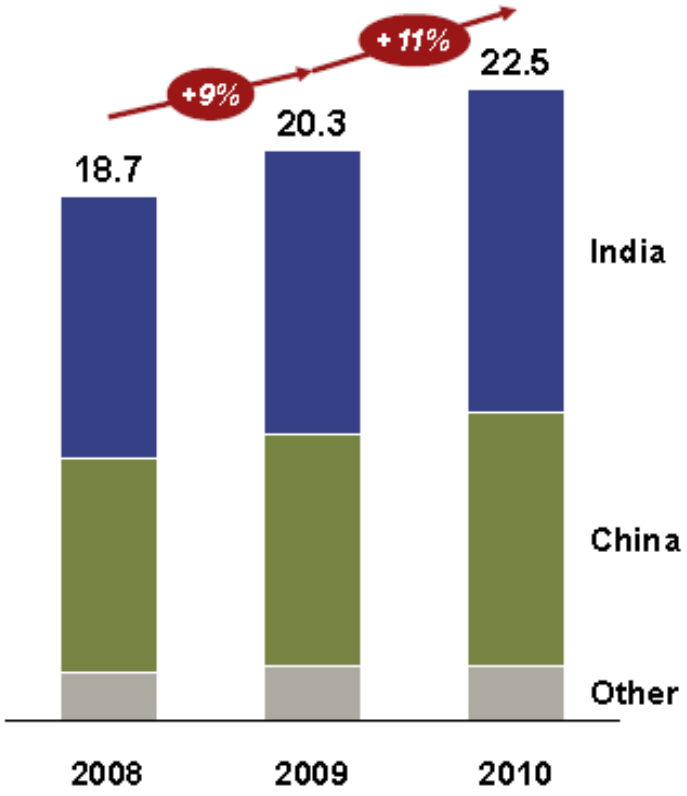


Fig.15: Offshoring R&D activities to India and China in the years 2008, 2009 and 2010 [10]

1.9 Portfolio rationalization among the OEM´s

Following the recession, most OEMs in developed countries will be looking for sustainable, profitable growth and not just volume. Yet emerging market OEMs will be reaching for scale as fast as they can, through acquisitions in either their home market or the developed world to build global brands and establish a global presence.

1.9.1 Low-cost high-tech

Small and basic car segments are the most influential growth drivers.

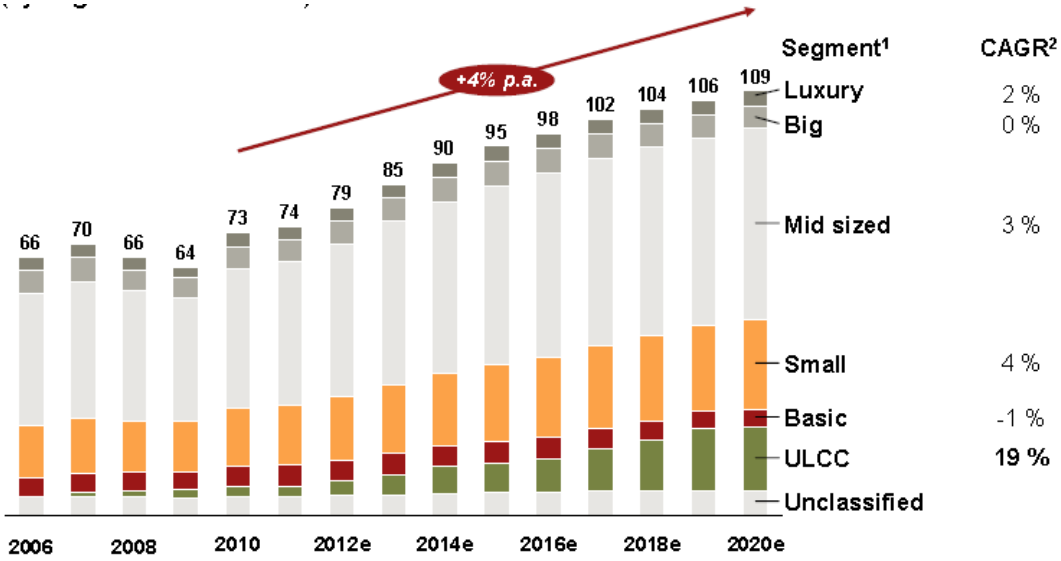


Fig.16: Development of global automotive sales, by segments in Mil. units [15]

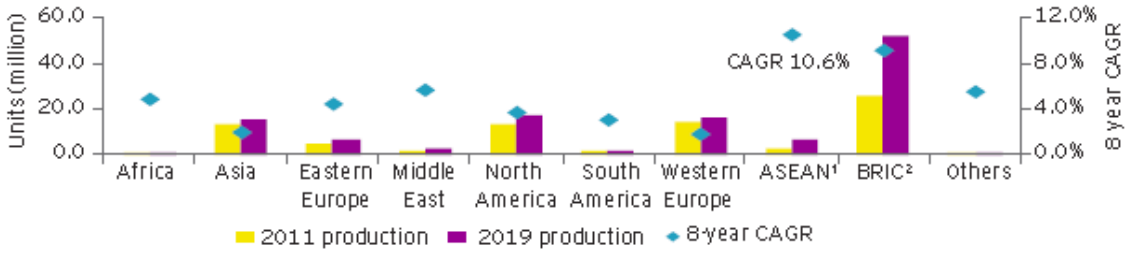


Fig.17: Global light vehicle production 2011-2019 [15]

Low cost cars require highly efficient technique that is tailored to the client and the regional needs. Who wants to lead the market, the need to adapt products and production processes. Leading suppliers in that segment have not only to develop cost-effective products, but also the necessary innovative system solutions. To implement this, a symbiosis of all engineers is needed at the local thinking with the existing, extensive experience and expertise re-linked from the developed markets.

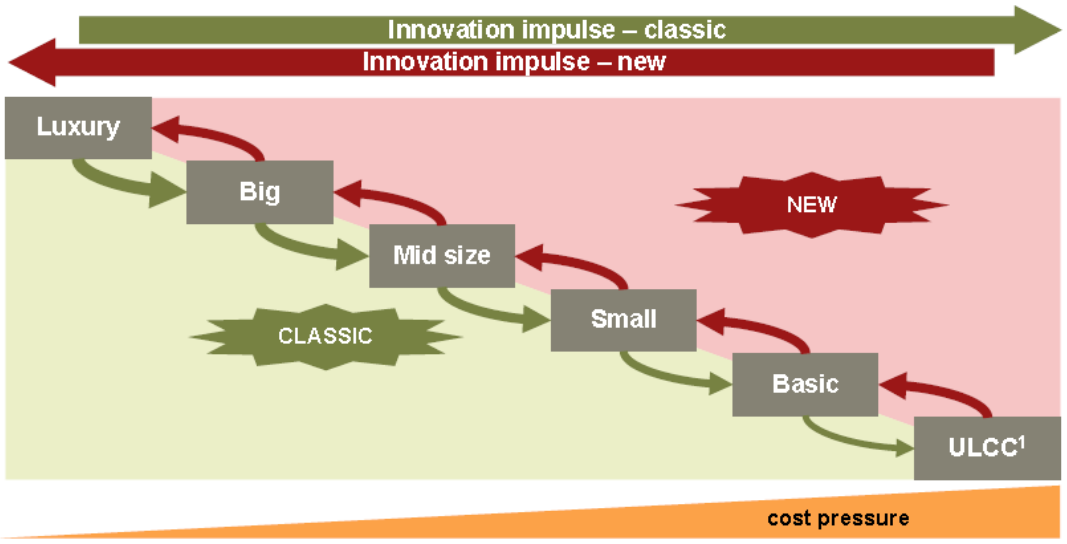


Fig.18: Innovation impulse changing direction from top down to bottom up [15]

The trend towards small vehicles will result in technological impulses from bottom to the top.

Classically the innovation cascade was a top-down stair, innovative breakthroughs in the luxury class where gradually implemented the classes below, step-by-step. The future will look different also in that respect: the innovation cascade will be entered from behind, innovation grows from bottom to the top.

Low-price segments will be much more diversified as premium segments:

- Reduction of car-size
- Low-cost-Variants in all car-classes
- New innovation to market: Ultra-Low-Cost-Car ULCC-Segment

1.9.2 Ultra-Low-Cost-Cars

What is an "affordable" ULCC? Disparities in wealth and car ownership lead to different definitions of Affordable Car. While in India, such a vehicle to the end user is offered for the equivalent of just under 2,000 euros, the minimum price in China or Eastern Europe is about twice as high. Western Europe and

Japan differ because of the higher demands and set a price limit of 10,000 euros – but for major suppliers the term exceeds up to vehicles in the small car and compact class with 18,000 euros. In Japan, about one in three newly registered cars has become a "kei car". These tax-favored small cars are mainly used as second cars or car buyers run a tight disposable income – a kei car is "affordable" at a price of less than 1.5 million yen, or about 11,000 euros.

1.10 Globalization of the industry

OEMs are being challenged to devise radical operational strategies to tackle the new risks emerging from globalization. From demand-supply misalignment and volatile raw material prices, to changing regulatory policies and shortage of qualified workers in developed markets, the automotive industry's globalization efforts are facing a reality check today. In the face of these risks, the industry must implement mitigation strategies to enable the value chain to be flexible enough to adapt.

1.10.1 China

The Chinese Development Research Center, a think tank of the State Council, helped compile the yearly report on China's auto industry that predicts consumer demand will remain strong despite a slowdown in 2011. The CDRC predicts, despite a slowdown in 2011, the Chinese auto market may triple in size over the next 10 years (up to 2020). "The Chinese auto industry is likely to reach a peak of *50 million units over the next decade*," said Liu Shijin, deputy director of the Development Research Center (DRC) of the State Council. Liu made the remarks at a recent press conference for the release of an annual report on China's automotive industry. In fact that estimate is "conservative", he said, noting sales could hit even 60 or 70 million vehicles a year.
For the past two years, China's auto market has experienced explosive growth to become the world's largest. Vehicle production and sales in the country both surpassed 18 million units last year, a 38 percent increase over the 13 million sold in 2009. For the next 10 years, the auto sector, as a mainstay industry of China, will maintain a growth rate higher than that most other sectors. Without elaborating, he also predicted that China could be the world's biggest auto export base in the next decade. [22]

The yearly report, first published in 2008, was jointly compiled by the DRC, the Society of Automotive Engineers of China (SAE) and Volkswagen Group China. This year's report summarizes the past decade in China's auto industry. It also features a study on small and lightweight cars that offer big potential for China's automakers to reduce fuel consumption and emissions,

Japan is rolemodel for China

Japan is the role model in producing cars with small engine displacement. In Japan more than one-third of vehicles have engines smaller than 1 liter, while in China the ratio is just 6 percent, the report said. It also found that China's passenger vehicles have average carbon dioxide emissions of 182L/100km, compared with 154L/100km in the EU and 155L/100Km in Japan. [22]

1.10.2 Relocation of production and development

Like the car sales, the production of vehicles in treshold countries is growing strongest

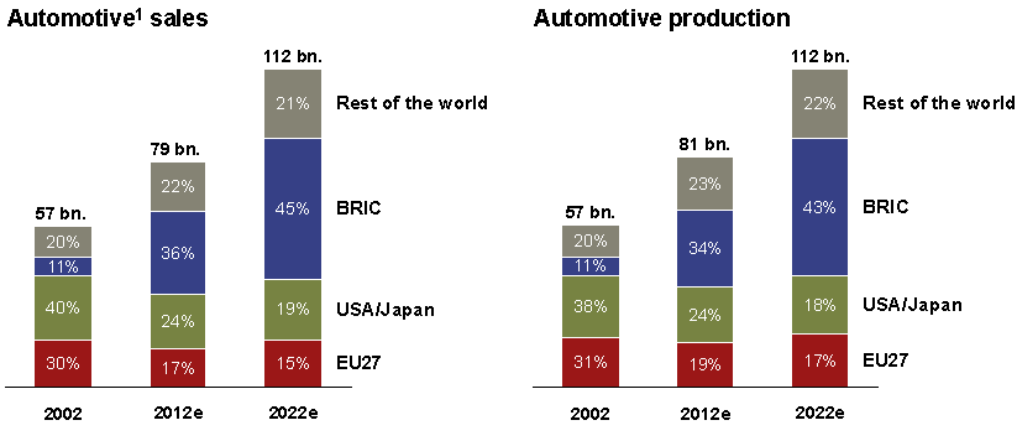


Fig.19: Automotive Sales and Automotive Production correspond to each other, [10]

In 2020, requirements for R&D resources in developing countries will exceed those in established markets by far. The number of required resources decisively depends on China´s development as most important growth

market. In each scenario resource requirements of developed markets are exceeded. European/Chinese joint ventures will for a comparatively long time (2020) profit from the modular kits developed in the headquarters which provides a technological edge over Chinese competitors. However adjustments have to be carried out on site in China.

The assumptions grounded on these scenarios are:

Scenario 1: 30 Mil. Vehicles in China, R&D multiplier 16

Scenario 2: 35 Mil. Vehicles in China, R&D multiplier 20

R&D requirements = (number of sold vehicles) x (R&D multiplier)/1000

R&D multiplier= number of R&D employees at manufacturer and supplier per 1000 vehicles sold. [12]

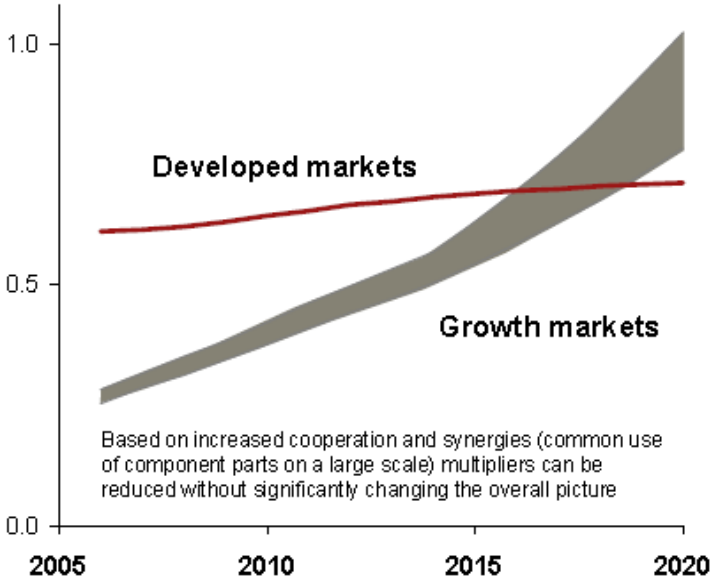


Fig.20: Development of number of R&D technicians, in Mil. FTE [12]

1.11 New strategies for TIER 2 and 3 suppliers

The dramatic tightening of belts at the OEMs and Tier 1 suppliers exposed the vulnerability of Tier 2 and 3 suppliers, in particular their relatively weak financial health and the absence of product, market and customer diversity.

However, rather than simply try to cope with increasing demands to do more with less, Tier 2 and 3 suppliers will need to become increasingly strategic. The winners are likely to jettison non-core businesses for greater profitability and diversify their risks by creating relationships with a range of OEMs, and developing products that can serve customers, even outside the automotive ecosystem.

1.11.1 Modularization

The advantage of a global platform is in the savings, but this strategy contains many risks.

Advantages of global platforms:

- Economies of Scale in Purchasing/Production
- Shorter Development Cycles
- Low Cost-Derivates

Risks of global platforms:

- Global availability of materials
- Constraints regarding model differentiation
- Quality faults within high volume components

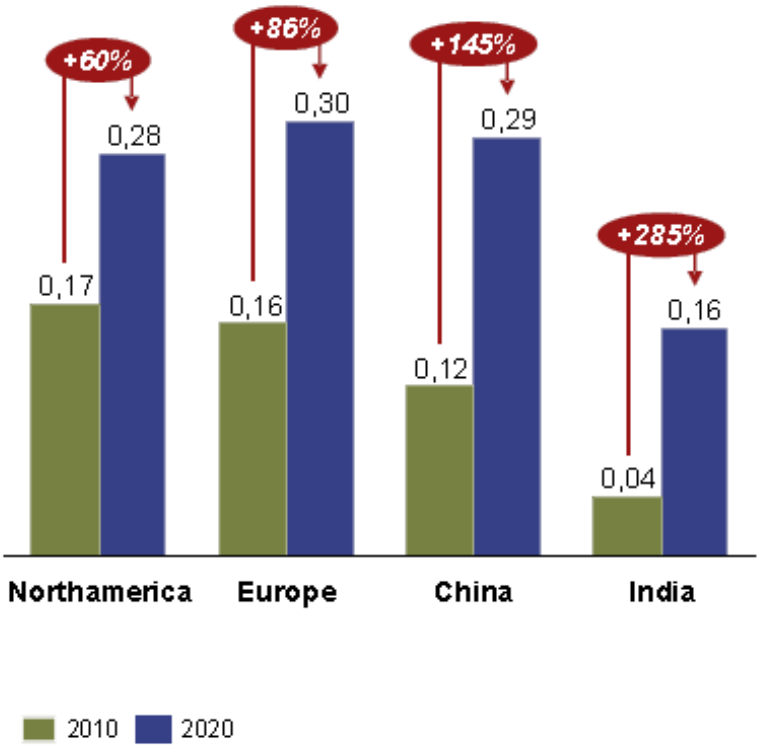


Fig.21: Development units per platform (mio. vehicles per platform, 2010 vs. 2020, [12]

OEM´s are streamlining their value creation process and are increasingly relying on suppliers. The shift in value creation is shown in the following graph:

Fig.22: history and outlook of value creation OEM vs. suppliers in departments, [12]

The development shown has 2 major side-effects for suppliers and for OEM´s:

1. OEM´s gain flexibility by handing over major value-generation-structures to their suppliers. This results in a lesser vulnerability to any changes in the carindustry, risk-mitigation is the key-word. This risks have to be shouldered by the suppliers, especially Tier 2 and 3 suppliers will be faced with completely new business models as depth of value added activities will rise rapidly.

On the other side Suppliers gain a huge variety of opportunities by taking over a much greater volume of value creation.

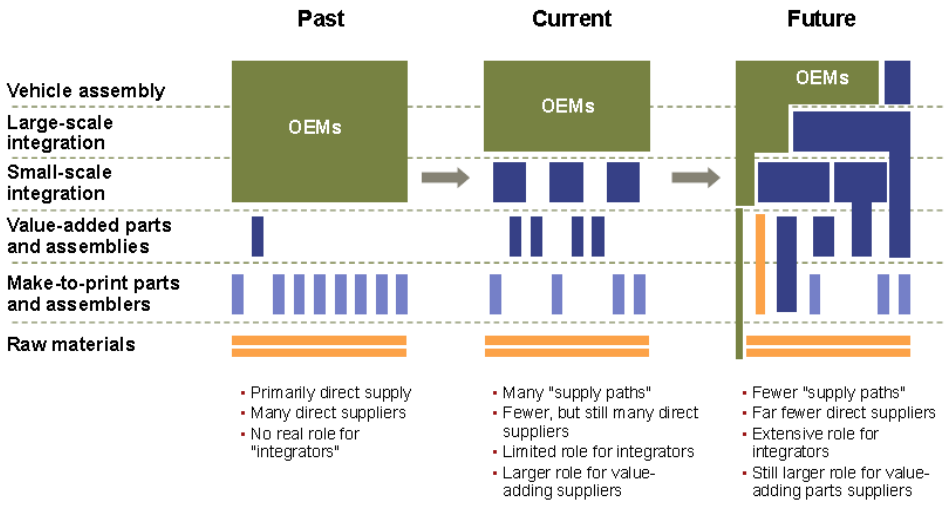


Fig.23: History and development of value creation major production processes, [12]

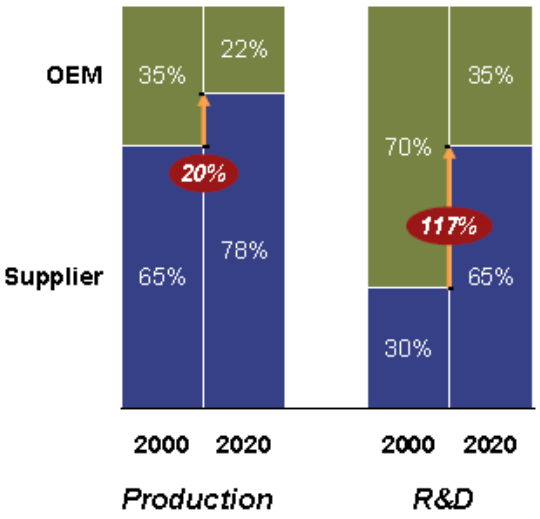


Fig.24: Development of value creation OEM vs. Supplier in Production and R&D, 2000 vs. 2020, [12]

- OEM´s are concentrating on technological core competences, marketing and sales
- Tier-1 suppliers develop integration competences via module and systems
- We realize a very intensive consolidation tendency of suppliers in treshold countries
- Embedded systems as drivers of change in value generation structure

The change of the role of the supplier has a strong impact on the industries business models. The supplier as integrator and value-added parts supplier takes over considerably amounts of production steps.

In this way the value generation structure and required depth of portfolio of the supplier industry changes fundamentally.

The position of supplier operations in the value chain:

- In the future, a few tier 1 suppliers coordinate the supplier network for OEM´s
- A central position in the supplier network requires innovation and coordination potential, at the same time higher margins can be achieved.
- That means that OEM´s are buying in mitigated risks and paying by reduced margins per sold car.

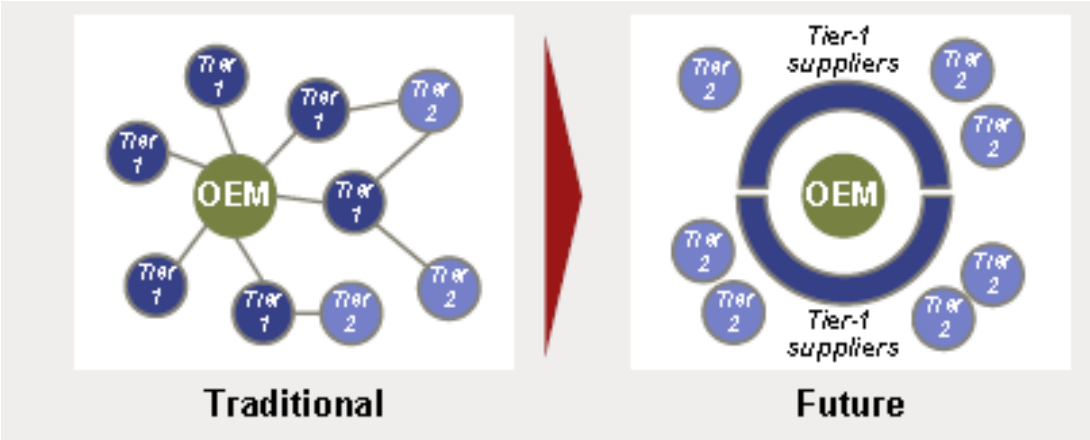


Fig.25: OEM/Supplier cooperation framework changes from network-form to centralistic form, [12]

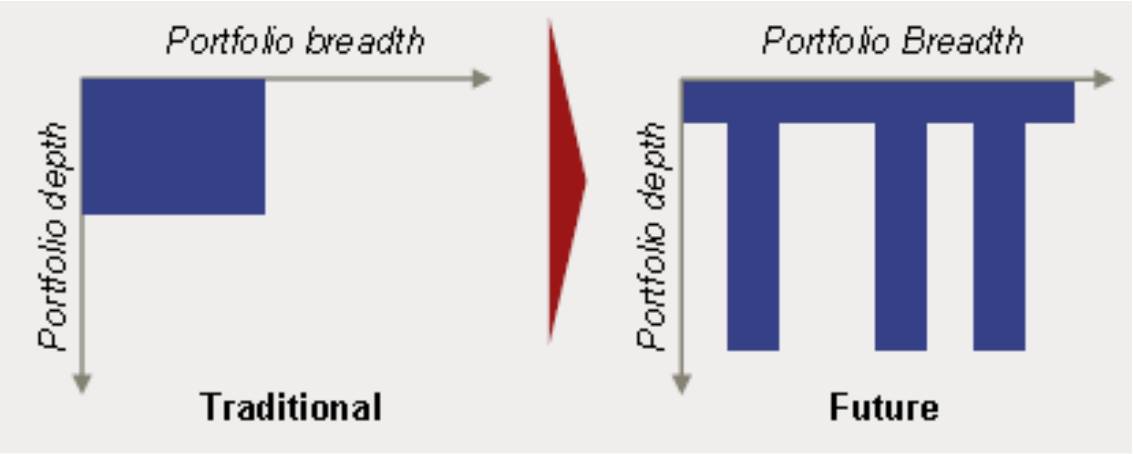


Fig.26: Suppliers traditional vs. future portfolio breath and portfolio depth, [12]

Strategic direction setting of offerings by tier 1 suppliers:

- For remaining profitable in a tier 1 position, a strategic direction of the entire offerings is required.
- Successful tier 1 suppliers operate with a very broad and deep offerings and technology portfolio and take interest in selected technologies in parts and components manufacturing.

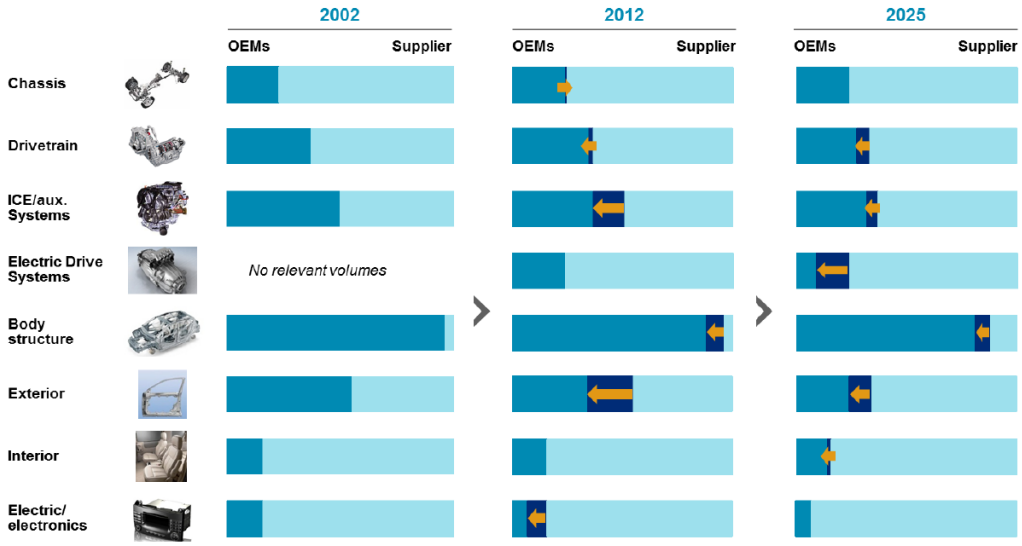


Fig.27: Oliver Wyman value creation model 2015

1.12 Sustainable urban transportation

Into and around the city, people and goods are always moving. Intelligent transportation systems improve capacity, enhance travel experiences and make moving anything safer, more efficient and more secure. Traffic managers gain citywide visibility to help alleviate congestion and rapidly respond to incidents.

The world population is growing. People move from the countryside to the cities. And the cities become megacities - 27 such cities with more than five million people are now available. And there will be more soon.

"For the first time lived in the last year, more than half of the world population

live in cities. If the population grows by 2050 to 9.2 billion, then three out of four people will live in cities.

Urban performance currently depends not only on the city's fitting of hard infrastructure ('physical capital'), but also, and increasingly so, on the availability and quality of knowledge communication and social infrastructure ('intellectual capital and social capital'). The latter form of capital is decisive for urban competitiveness. It is against this background that the concept of the smart city has been introduced as a strategic device to encompass modern urban production factors in a common framework and to highlight the growing importance of Information and Communication Technologies (ICTs), social and environmental capital in profiling the competitiveness of cities.[1] The significance of these two assets - social and environmental capital - itself goes a long way to distinguish smart cities from their more technology-laden counterparts, drawing a clear line between them and what goes under the name of either digital or intelligent cities.[22]

Smart cities can be identified (and ranked) along six main axes or dimensions: [22]

- a smart economy
- smart mobility
- a smart environment
- smart people
- smart living
- smart governance

These six axes connect with traditional regional and neoclassical theories of urban growth and development. In particular, the axes are based - respectively - on theories of regional competitiveness, transport and ICT economics, natural resources, human and social capital, quality of life, and participation of citizens in the governance of cities.

A city can be defined as ‘smart’ when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic development and a high quality of

life, with a wise management of natural resources, through participatory action and engagement. [7]

It insists that smart cities are defined by their innovation and their ability to solve problems and use of ICTs to improve this capacity. The intelligence lies in the ability to solve problems of these communities is linked to technology transfer for when a problem is solved. In this sense, intelligence is an inner quality of any territory, any place, city or region where innovation processes are facilitated by information and communication technologies. What varies is the degree of intelligence, depending on the person, the system of cooperation, and digital infrastructure and tools that a community offers its residents [8].

1.12.1 Example of Smart City Solution made by IBM

Traffic congestion and gridlock

Sitting in a traffic jam is not just annoying—gridlock affects commerce and safety as well. All those vehicles idling on clogged roadways also contribute to pollution. But with shrinking budgets, cities often don't have adequate funding to rebuild or expand aging infrastructures, so it is crucial to find smarter ways to optimize existing assets. Intelligent transportation solutions are designed to reduce traffic congestion, improve incident response, optimize traffic flow and help you proactively manage traffic conditions. [15]

Paving the way for innovation

Intelligent transportation solutions provide traffic analysis and prediction capabilities and a comprehensive, scalable platform for traffic management solutions. It aggregates data from multiple devices that identify and measure traffic speed and volume on city roads. Providing near real-time citywide visibility into traffic conditions, it can capture data from disparate sources, such as cameras, radar and under-road loop detectors, as well as systems based on Bluetooth or mobile phone technology.

With the intelligent transportation solutions, a 360-degree of the entire transportation infrastructure is achieved. It integrates existing technologies into a single information model for advanced analysis and sharpened visibility of traffic incidents. The predictive analytics capability in the intelligent transportation solutions leverages historical and real-time traffic data to

predict future traffic conditions. It adopts a system-wide analysis method, so the solutions can offer industry-leading accuracy when predicting conditions such as traffic speed and volume, up to an hour in advance. [15]

Efficient transportation management

The intelligent transportation solutions helps reduce traffic congestion through more efficient management of transportation networks.

a. Analyze historical data to gain performance insights and understand patterns of behavior of traffic and road incidents.

b. Predict traffic speed and volume up to an hour into the future based on analysis of real-time and historical traffic data.

c. Increase situational awareness across your entire transportation network.

d. Centrally manage traffic operations and traffic event information collected across geographic locations.

e. Enable vertical value applications through a standardized and scalable information model.

1.13 Demographic development

The world is ageing rapidly. The number of people aged 65 and over will double as a proportion of the global population, from 7% in 2000 to 16% in 2050. By then, there will be more older people than children (aged 0–14 years) in the population for the first time in human history. [17]

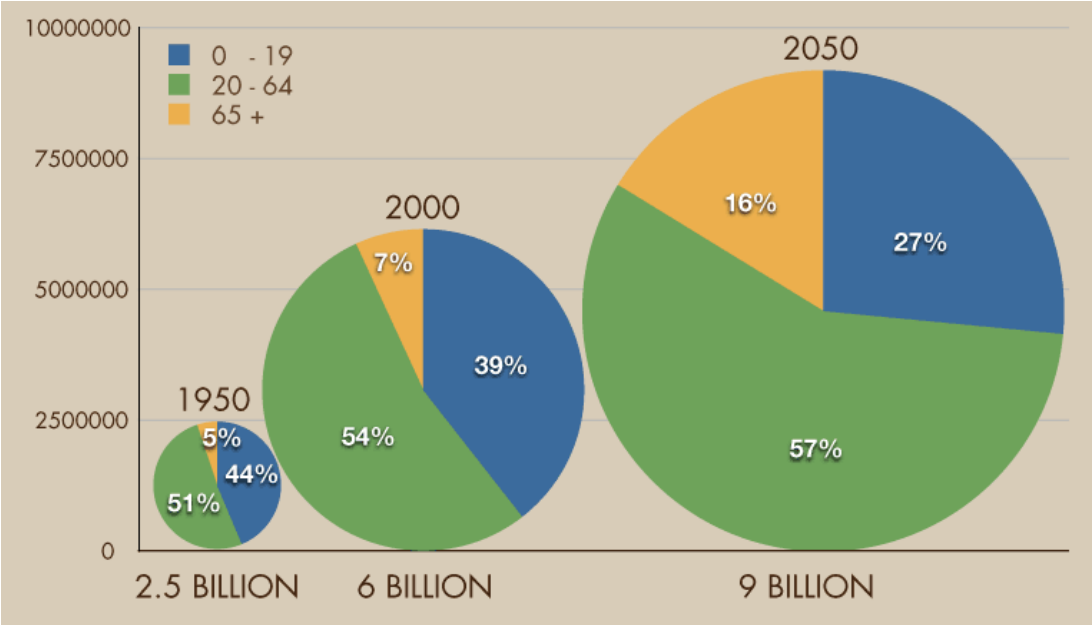


Fig. 28: Ageing Societies, population by age group {17]

Scientific and technological advances, industrialization, socioeconomic development, improved communication, better hygiene and increased food intake have helped to increase life expectancy and reduce mortality rates in recent decades. Since 1840, global life expectancy has indeed risen in a linear fashion for both sexes, with an increase of almost three months per year for women. [17]

The most dramatic gains have been in East Asia, and Japan is no exception: it is now the most aged society in the world.

A society with fewer children

Following a period of rapid growth that started in the late 19th century, Japan's population started to slow in the 1980s with an annual pace of growth that averaged 1%. Since the 1980s, this rate has declined sharply with 2005 being the first year of decrease in the total population.

More than 20 other countries are projected to experience a similar shrinking of their population in coming decades. In the next five years, citizens over 60 years old will outnumber children under 5 for the first time globally. In Japan, the elderly have surpassed the younger age group since 1997.

Low fertility rates in many societies, below that needed to replenish the population, are hastening the demographic transition occurring worldwide.

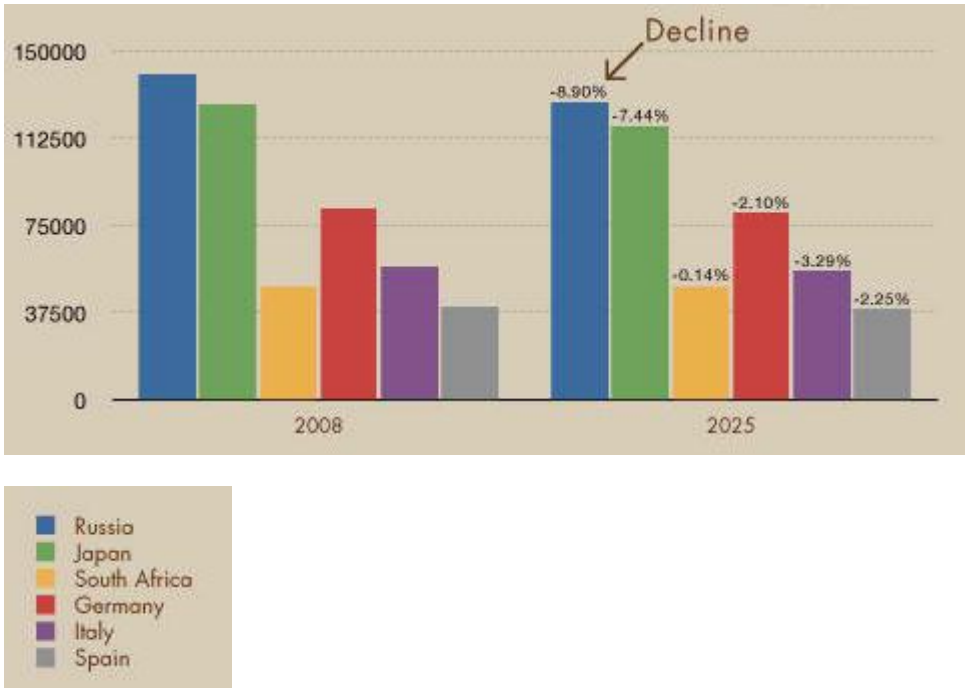


Fig.29: Ageing Societies, projected population decline for selected countries, 2008 -2025 [17]

Ageing societies have impact on the car industry

1. Older people quit driving at an average age of 75
2. Car industry has to consider the consequences of elderly people driving
3. Electronic safety systems are having a positive impact on safety of mobility of aged people

Numbers of young car drivers are declining

The frantic rush to get a license at 16 — once a staple in American adolescence — is disappearing as Internet access and stiffening driving rules have led teens to wait longer to beg for the keys. Hannah Hart, 17, a high school junior in Atlanta, has had a learner's permit for almost two years but says digital access to friends, games and other activities has kept her and her peers from getting their full licenses. [11]

In 2010, 28% of 16-year-olds had driver's licenses, compared with 44% in 1980, according to research by the U.S. Department of Transportation and the University of Michigan.

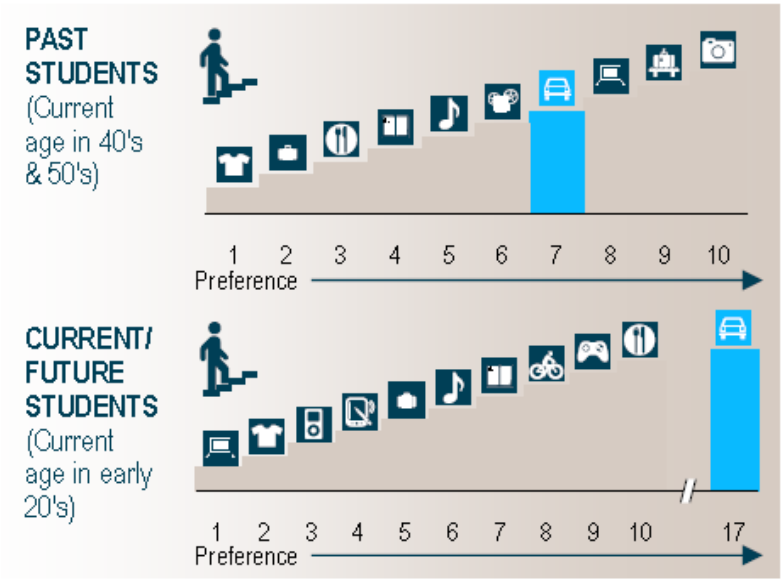


Fig.30: Focus of interest differing between former students and current students [11]

The number of older licensed teens also has dropped from 1980 to 2010: 17-year-olds went from 66% to 45%, 18-year-olds from 75% to 61%, and 19-year-olds from 80% to 70%.

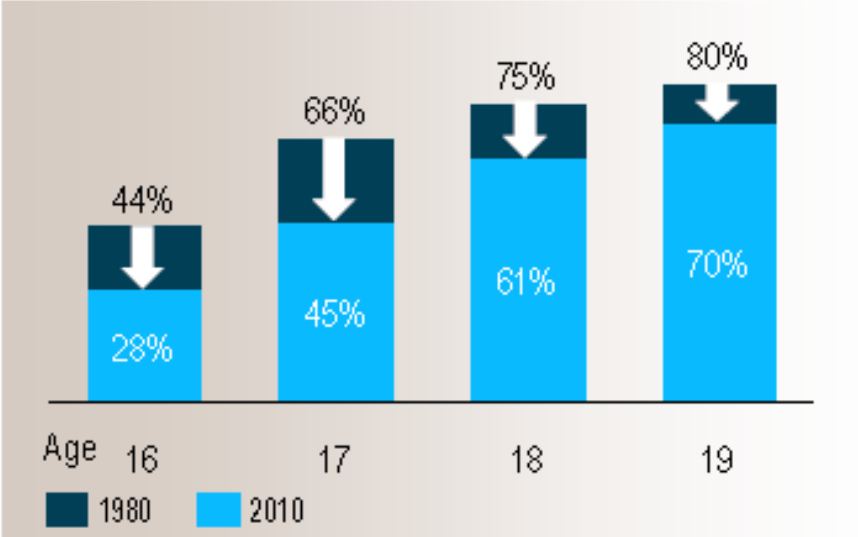


Fig.31: Teens with a license in the US from 1980 to 2010. [11]

Internet, smartphones and economic downturn

Additionally to aging societies young people are turning away from individual transport. For younger consumers, the smartphone may be the shiny new cars from previous generations. Access to the Internet is more important than access to individual mobility.

The following reasons are decisive for this development:

1. Social contact is increasingly taking place in the www.
2. The current economic downturn has made it more difficult for young people to own a vehicle
3. An increasing number of young people are moving to cities that have regular public transportation
4. Young people, concerned with the environment, are opting against having cars or licenses.

This development has further consequences:

Ageing societies result in reduced capabilities to access individual transport, at the same time young generations are turning away from individual transport.

3. Expert Opinions

The following interviews were made with experts out of car industry and surrounding industries like IT.

1. Mag. Michael Schramm and Norbert Seibel, Smarter Cities IBM Experts
2. DI Michael Düsterwald Siemens Product Manager Intelligent Traffic Systems
3. Martin Keil, BMW Strategy, Product and Communality Definition Traffic Technology and Traffic Management
4. Takatsugu Kosuge, Toyota Group Manager, IT&ITS Planning Division
5. Fotis Karamitsos, EC Europe

The outcome of these talks are displayed in the following section:

3 focus issues for future mobility

To describe the future development of Individual Mobility we have to differentiate between 3 spheres of the issue.

1. Mobility itself
2. Cars
3. Infrastructure

We have to abstract between mobility and cars. Classically mobility means:" I have a car", but the approach of the next generation will be: "How do I get from A to B?".

The development will be done step by step, there is no time for revolutions

First transition period

The second cars in households will be replaced by alternative solutions, like usage of car sharing systems or systems like Car2Go. The alternative of public transport will rise in importance to the households. This phase is starting right now.

Second transition phase

The primary cars of households will be incrementally replaced by alternative cars with alternative powertrains, like e-cars (battery based and fuelcell-based), hybrid-systems. This phase of transition is influenced by the technological development in powertrains. Due to this fact, this transition phase will significantly roll out with the year 2015-2020.

Third transition phase

The primary household cars are replaced by mobility systems like car sharing and public transport systems. This phase is about to significantly roll out with the year 2025.

The following critical aspects are hindering fast transitions of transport modes from individual transport to public transport:

1. Individuality: Having the freedom and possibility to choose where to go and when to go there
2. Comfort: Especially families have very individual requirements to transport, space, safety and speed are factors that only can be met by individual transport, today. And there is no alternative showing up.
3. Restricted time budgets: Individual transport is in the majority of the cases the fastest way to get from A to B. This will be the case for the next 10-15 years.
4. Restricted money budgets: The cost/performance ratio of Individual transport is still attractive and will be politically be held on an attractive level.

IT makes Multi-Mode-Mobility viable

Governmental regulations, like road charges, inner city tolls, parking fees and taxes are major steering forces for the future.

Information technologies are changing the future of mobility dramatically. The connection of different mobility systems is driving the tendency for Multi-Mode-Mobility, connecting individual mobility with public mobility systems. This development creates the opportunity to interactively guide people

through urban and rural areas by systematically advising and organising mobility connections. These systems are in the planning phase right now, rolling out to the market in the next years.

Practically these systems are offering the best way to a given destination and calculate the best way back to the place of departure.

There is a tendency that cars are becoming significantly impersonated, the generation of “car-junkies” is slowly dieing out.

The actual generation is learning to live without a car

If people are experiencing to live without personal access to cars, the critical mass of multi-mobility-users is rapidly increasing. It is all about learning new habits. Most of the older generations are simply used to cars. The established habit of using a car that is always available will continuously break away. Young generations already experience a time that offers the possibility to live without cars.

If this young generation is taking this experience, made during school and studies, into their professional lives, the consequences can´t be foreseen from the present standpoint.

4. Strategic spheres for the Automotive Industry

From the generic strategically point of view the Automotive Industry is changing dramatically in the next 2 decades. Especially the following strategic objectives will gain importance to the industry.

- Flexibility
- Innovative Technology
- Global Cooperation
- New Business Models

Regarding the 13 Megatrends, the following strategic spheres are the guideline for the Automotive Industry:

1. **Travel Time Budget (TTB) and Travel Money Budget (TMB) are constant:** People are tending to use transport modes that best fit to their used TTB and TMB, this counts for all societies. OEM´s have to be prepared for developments especially in megacities that are contradicting their actual strategies. Today all forecasts are seeing continuous growth of sales as well as production numbers, especially in China and India. But growth in individual transport systems means congestion and herewith rising TTB and TMB. Consequently people will change for alternative transport modes if the Automotive Industry is not capable to find their strategic position within Smart City Concepts.
2. **Growing number of Megacities:** The number of Megacities are growing, the Megacities themselves are growing. According to the results found in chapter 2.2, cars are still within the plans of infrastructure in the Megacities, but it is evident that alternative transports modes like trains and airplanes are growing much faster than car traffic. How will traffic in megacities look like after 2025? It is hard to say now, but one thing is for sure: high population densities don´t match with individual car traffic – the task is to shovel the masses from A to B – and we already know that cars are the worst transport mode to fulfill this task.

3. **Governments push for safer and cleaner environment:** Individual car traffic is causing macroeconomic costs through indicated health problems due to noise-and air-pollution, accidents as well as waste of resources due to congestions. Major Chinese Cities are holding against this development with regulations containing these problems. Car plate lotteries, rising taxes and parking costs for non-green cars are the latest actions seen in China. Furthermore major efforts are undertaken to rise up the e-mobility-station grid. These developments are clearly indication that especially in Megacities e-mobility is stepping forward.

4. **OEM´s develop new value proposition to meet shifting mobility needs:** e-Mobility, small-car-policies and alternatives to owning a car are clearly on the fast lane. The industry reacts to the change lying ahead – and industry reacts partially excellent, as to be seen in the Car-2-Go-undertaking by Daimler and others. But the majority of the car industry is reacting slowly and seem to be reluctant to act now.. It is decisive for OEM´s to respond to changing requirements of people living in high-density areas and in developing countries. It is a fact that the future takes place in Asia. The solutions that are found in China today will sweep back to good old Europe and USA. It is only a question of when.

5. **Change of intra-urban mobility:** People in cities are mobile – but modes of mobility are changing rapidly. Cars are wasting space, from this standpoint, walking and cycling are the most efficient modes to go from A to B. Besides of this fact, car-sharing systems could reduce car-parks in Cities like Vienna by 80%. This is the potential. People are welcoming new transportation-systems, naturally a complete acceptance is not realistic. But still: Switzerland has ten times more users of car-sharing-systems than Austria. And numbers are increasing. In this respect Europe is ahead, and it is expected that slowly this new trend will also sweep into the Asian market.

6. **Electrification of powertrains:** Electrification isn´t a trend, it is the future. As already pointed out the only question is, if fuel-cell technology or battery technology or a mixture of both will conquer the markets. OEM´s that haven´t invested in this technology years ago, will lay behind tomorrow.

7. **New players take the lead in the mobility market:** Google is taken as an example of what contributions may be expected in the future from branches, that have nothing to do with Automotive Industry today. Completely unprecedented cooperation's and acquisitions are about to show up in the near future.

8. **Collaboration among industry stakeholders:** Industry´s collaboration activities are changing – outsourcing of former key-elements is no longer a tabu. Seen globally R&D-activities are offshored, Developing countries like China and India are taking the majority of growth in this segment.

9. **Portfolio rationalization among the OEM´s:** What type of cars will be bought in 2025? The trend is clear – lowcost-hightech is the credo. The so called ULCC – ultra low cost cars are showing growth rates of foreseen 19% in the year 2020, all other car-sizes are growing in single digits. OEM´s that want to have a share of this cake have to be quick – the Asian market is already on its way for ULCC´s.

10. **Globalization of the industry:** China´s prospect for the year 2021 - 50 Mill cars produced in the country. The focus of every OEM should lay on China and India – European carmakers are fighting against the fast learning Chinese and Indian carmakers – the battlefield is Asia. The near future is a very competitive one, Europe will lose plants to China – and future has already begun. Opel has started by closing Bochum. But others are about to follow.

11. **New strategies for TIER 2 and TIER 3 suppliers:** Supplier are changing fundamentally in the next decades, gaining depth and breadth in the value creation chain, but taking new risks from the OEM´s. Experts see this development critical, because this trend leads to unexpected effects: Major suppliers jumping into the ring of the OEM´s could be a future prospect. This strategic danger could slow down this tendencies – resulting in ping-pong-effect. OEM´s have to define their strategic valuable value-creation activities and keep them in the house.

12. **Sustainable urban transportation:** Smarter Cities Concepts are a worldwide trend aiming at reducing car transport or congestions and increasing the usage of sustainable modes of transportation.

Information technologies are challenged to connect data of public transport modes with individual transport modes- resulting in optimized and “green” movement of people and goods. The multitude of approaches are stunning, starting from traffic prediction systems up to intelligent travel-apps for mobile phones guiding people through time and space by using all available modes of transportation. Interestingly the car industry could draw profit out of Smart City Solutions, and cooperation´s with City Councils should be a major topic: If Smart City Solutions help reducing congestions on the roads, the industry is bailing out for quite a long time.

13. **Demographic development:** Older societies mean less individual traffic. Interestingly Asian societies are aging faster than European societies, resulting in people that are increasingly incapable to drive cars. The development of lesser people being capable to drive cars is supported by a tendency of young people avoiding car traffic. Car Industry has to take care of this fact. New technological innovations making roads safer for elderly people is one side of the medal, accessibility of individual driving for the seniors is the other one.

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