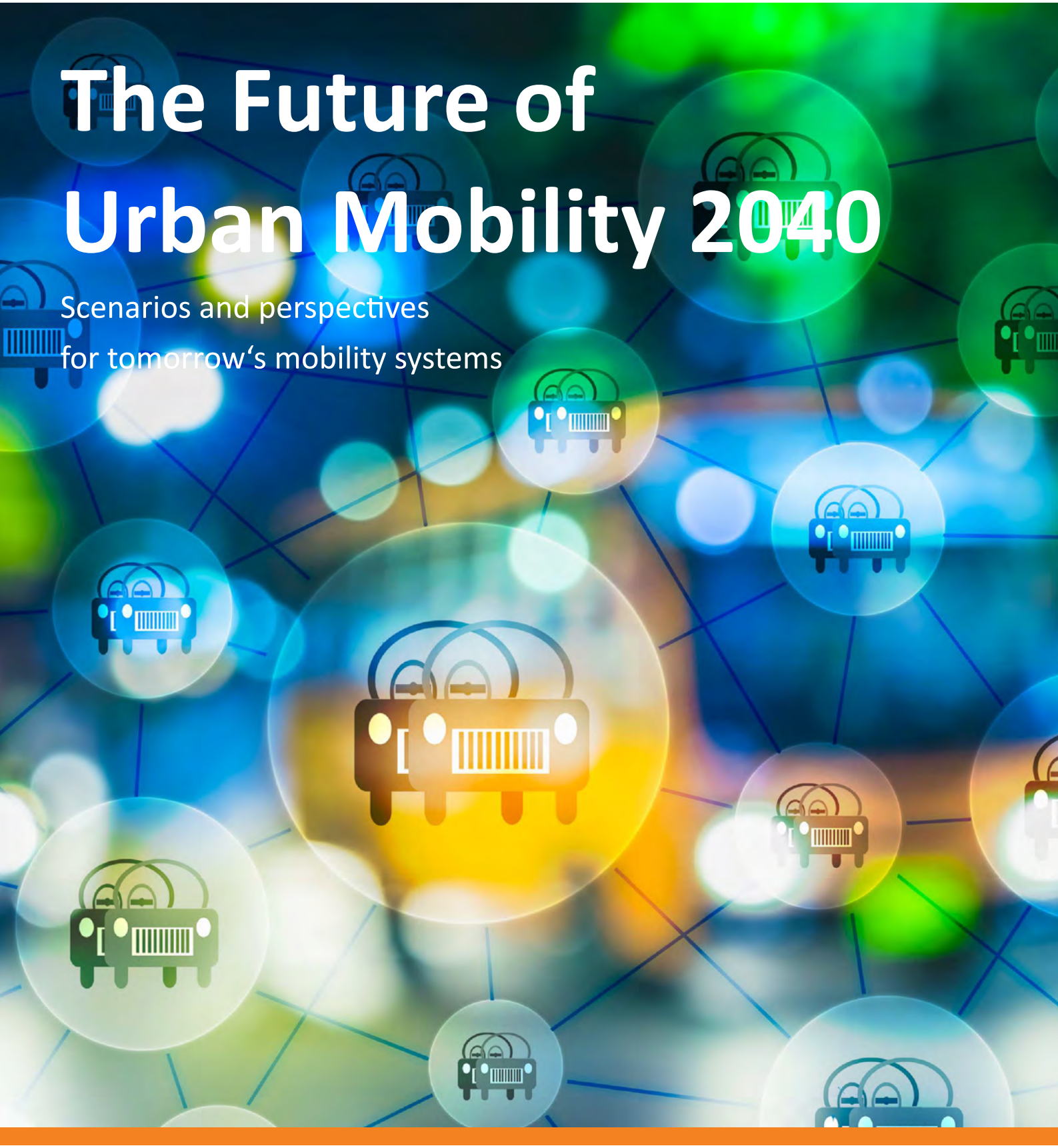
Scenario Management International
Corporation for Future Research
and Strategic Management

The Future of Urban Mobility 2040

Scenarios and perspectives for tomorrow's mobility systems



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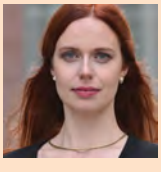

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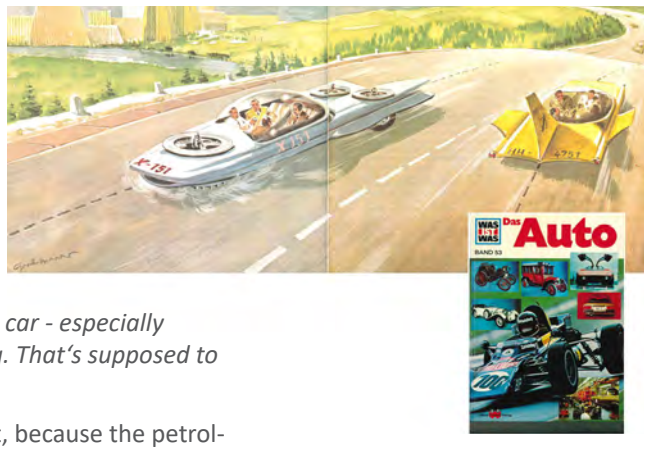
ScMI AG is a public company founded in 1998 for future design and strategic corporate management. ScMI supports companies and organisations in the development of future scenarios and visionary strategies, as well as in the design and implementation of strategic planning, innovation and change processes.

*Since its founding, ScMI has cooperated with most of the German DAX-companies, as well as with innovative market leaders and public facilities in and outside of the country in the area of Szenario-Management™. Additionally, it has developed the scenario method further so that even small and medium-sized companies, business and functional areas, as well as regions and communities can use it in a beneficial manner. (**www.scmi.de**)*

Preface:

Revolution or no revolution?



Some time ago, while strolling around a flea market, I found an old WAS-IST-WAS book (a popular German book series) entitled »The Car« dating back to 1974, in which the chapter on the car of tomorrow said: *»Nobody knows what the car of the future will look like. But one thing seems certain: It will bear little resemblance to the car of today. ... But if you compare a car built in 1934 with a car today (1974), you will come to the astonishing conclusion: not much has changed since then. In principle, it is still the same car - especially if you look under the bonnet: it's still the same gasoline driven heart beating. That's supposed to change now.«*

But today - again more than 40 years later - you could repeat this statement, because the petrol-driven heart is still beating. And we are discussing a variety of topics that already found their way into the aforementioned WAS-IST-WAS book in 1974: the electric motor, the fuel cell, a car called »Firebird«, which is driven via a »car checkpoint« (autonomous driving), car sharing and the end of private cars. Are we now faced with the described change in our mobility system, or will we look back in 2059 and ask ourselves again why we have mercilessly overestimated the forces of change on the second attempt?

Once again, it is worth taking a look at the WAS-IST-WAS book: because despite all the foresight, something seems to be wrong with the pictures. It took me some time to realize that all the streets in the book are empty. No traffic jams. No overloaded infrastructure. And no environmental problems. Here it becomes clear that the trigger for change - or should we better say problematic situation - has changed fundamentally. Particularly in centers of urban life, it becomes clear that the current volume of mobility leads to tensions, whether due to environmental pollution or to lifetime lost in traffic jams. The debate about the mobility of the future has reached the heart of society, as is shown not least by the demands of the »Fridays for Future« movement regarding the pricing of CO_2 consumption.

But what does the future of mobility look like in the year 2040? Will combustion engines dominate, or will electric motors take their place? Will we need our own cars in conurbations – or will they become obsolete? Will local public transport become more attractive? Are conurbations developing into green oases or grey pollution magnets? And what are the prospects for the automotive industry? Will demand for existing transport concepts remain high or will a strategic redirection be necessary? What role does digitalization play? Will our roads be smart and our means of transport networked?

These and similar questions can hardly be answered exactly. Instead of looking for the one, all-explaining megatrend, decision-makers in business and politics – as well as the general public – have to deal with different, possible futures. With this basic understanding, the ScMI 2009 developed scenarios for the future of mobility in conurbations for the first time. This study was frequently quoted, repeatedly presented in numerous lectures and also served as the basis for many individual scenario processes.

Now – after almost ten years – it has become clear that new key factors have emerged and new development perspectives have opened up. It was therefore time to design a new »map of the future«. This was done in a scenario process together with ten partners to whom we would like to express our thanks for the excellent cooperation – Deutsche Bahn Connect, BMW Motorrad, Bosch, hannoverimpuls, Hermes, the Lower Saxony Innovation Centre, KNORR-BREMSE, MAN, NTT DATA and REWE GROUP. Our special thanks go to Gudrun Kneißl of effisense and Dr. Kai Hudetz of IFH, who supported and accompanied the scenario process in terms of organisation and content. We wish you, dear readers, many new insights on this journey into the future.

Dr. Alexander Fink
Executive Board

»Private cars will be virtually non-existent any day soon. Everywhere on the street corners there will be rental cars that anyone can drive. If you have to go to work or want to visit friends, put a credit card into a slot inside the car when you enter the vehicle. The card is scanned electronically and the driver drives off. Once he has reached his destination, he simply leaves the car at the corner. The computer calculates the fare and automatically deducts the money from the driver's bank balance via a clearing account. [...]
The few who still want the luxury of a private car have to dig deep into their pockets. Because the number of private cars - probably far more luxurious - would be small and their unit price correspondingly high. This would close a strange cycle: The private car would then be what it was at the very beginning of its history - the expensive toy of rich people.«

See: WAS-IST-WAS, Vol. 53, Das Auto, Neuer Tessloff Verlag, Hamburg 1974.

Joint scenario process:

The road to scenarios

The scenarios described in this study have been developed in a collaborative scenario process based on the methodology of Szenario-Management™. The process was supported by ten companies and organizations. These project partners contributed their own perspectives and views, some of which were very heterogeneous, and thus contributed significantly to the scope of the results.

The term »scenario« is used in very different ways. Szenario-Management™ defines a scenario as one of several systematically developed pictures of the future, which is used in combination with other scenarios to describe the »space of possibilities«. Such future scenarios are developed in four steps:

Which key factors determine the scenario field? (Step 1):

First, the defined scenario field was systematically structured and presented in a system image. The results and analyses from the preliminary project were taken into account and further developed. Then the individual influence areas could be described by a total of 91 concrete influencing factors. Not all of these influence factors equally drive future developments. Therefore, an interconnection analysis was performed to point out the interaction between the single factors. The systemic behaviour of the individual factors was examined with a network analysis:

- Future dynamics can be identified above all by means of the so-called system nodes. These were, for example, integrated mobility offers, the development of the automotive industry, the attitude and significance of mobility and the development of autonomous driving.
- Relevant external influences are often displayed as system levers. These include the role, power and identity of metropolitan areas, transport policy and road design, as well as the environment, economic structures and technological development.
- System indicators point to rather lagging but often volatile changes. These include the mix of different modes of transport, the postal, parcel and delivery services and the structure of public transport providers.

Based on this analysis, the scenario team finally selected 25 key factors – the questions, so to speak, for which the scenarios are intended to provide answers.

How could the key factors develop? (Step 2):

Subsequently, possible future developments were identified for each key factor. These future projections describe strategically relevant, characteristic and qualitative development alternatives for the individual key factors. During their

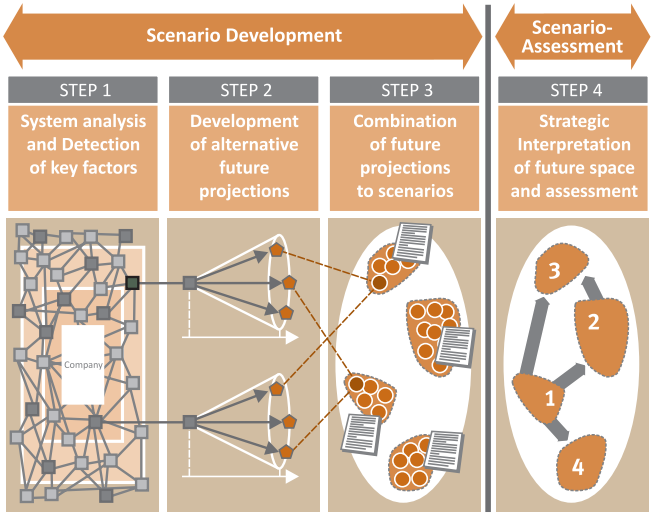
development it was important to identify alternatives that go beyond pure black-and-white thinking.

To which scenarios are the individual projections linked? (Step 3):

Scenario building began with an assessment of the compatibility of the individual future projections. This assessment of consistency formed the basis for analyzing all possible combinations – the so-called projection bundles – with the help of the ScMI software Scenario Manager. Using a cluster analysis, eight scenarios were then determined that best represented the »window of possibilities«. These scenarios are also graphically presented in a »map of the future«.

Which scenarios are to be expected – and how should we handle the map of the future? (Step 4):

Scenario development is usually followed by two activities: On the one hand, opportunities, threats and options for action can be derived for the individual scenarios – as well as indicators that show the occurrence of this future at an early stage. Secondly, on the other hand, the scenarios can be further analyzed and evaluated. This makes it possible to determine in how far future is expected to differ from the present and which development paths exist for this future.



The scenario team

The scenario team met for four individual workshops in Paderborn, Hamburg, Hanover, and Munich.

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Overview of the scenarios:

Our map of the future

Scenarios are descriptions of possible situations in the future. This means that, on the one hand, they should be vivid – just like an illustrated book or a movie from the future. On the other hand, the scenarios should give us an overview of the different possibilities: What are potential alternatives that we have to bear in mind? What is the »window of possibilities«? Therefore the scenarios are visualized in a »map of the future«, which could be used as a guide. The map for the future of mobility shows eight plausible scenarios.

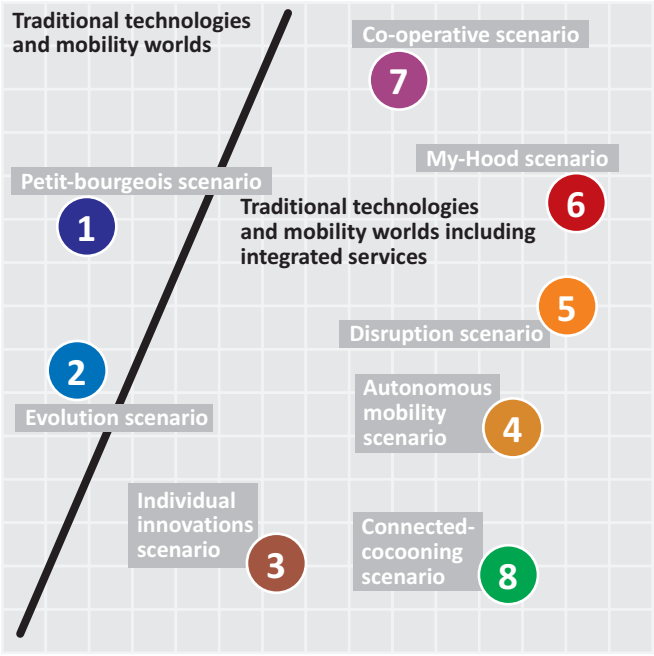
The scenarios shown in this study are based on 25 key factors, whose development potential is expressed by two or more dimensions. Consequently, there are at least 50 uncertainties in which the scenarios can differ. But how are the individual perspectives interconnected? And what are the dominant differences – the boundaries, so to speak, between the individual scenarios on the map? Our analyses include all key factors – from the economic and technological environment to integrated mobility services. In the process, we have come across many differences and a number of core dimensions – not just two or three. This illustrates the complexity of urban mobility environments, and at the same time the lack of suitability of simple explanatory approaches. These core dimensions – the most important uncertainties in the urban mobility environment – are visualised in a »map of the future«. In this map, the eight scenarios are arranged by means of multidimensional scaling in such a way that similar scenarios are close to each other. The core dimensions then appear as dividing lines within the map.

Between black and white

In the first interpretation of the map, the six core dimensions can be distinguished, which are arranged rather vertically:

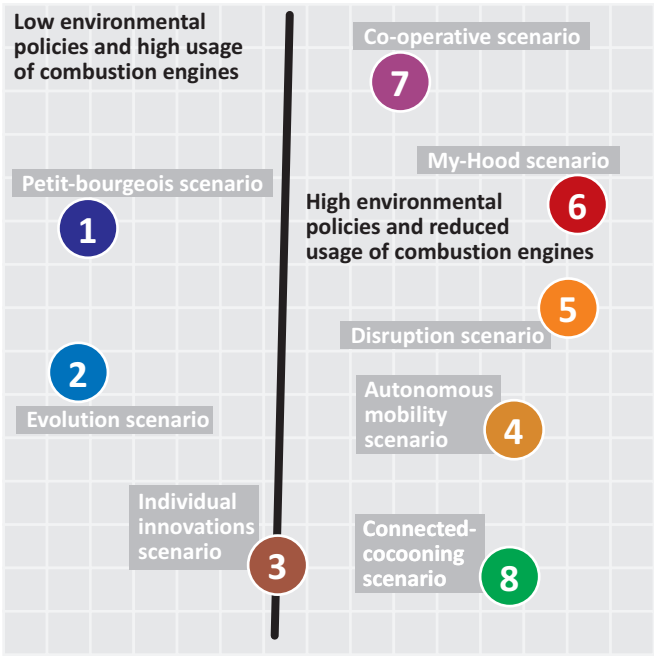
Which mobility technologies will dominate the future?

The two scenarios 1 and 2 on the left side of the map are determined by traditional mobility technologies and worlds. In the other six scenarios, new technologies and vehicle concepts with a high degree of conurbation compatibility prevail. In addition, integrated mobility services are of significant importance here.



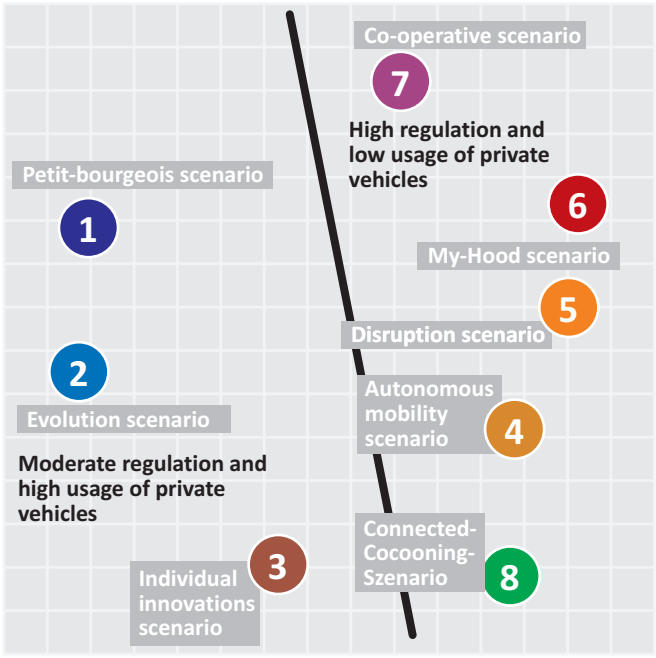
How will (environmental) policies deal with combustion engines in the future?

In addition to the more traditional scenarios 1 and 2, environmental policy also remains rather moderate in scenario 3. This means that in these three scenarios, combustion engines can retain a relatively strong position, while in the further scenarios, a restrictive environmental policy leads to regulations on traditional drive systems.



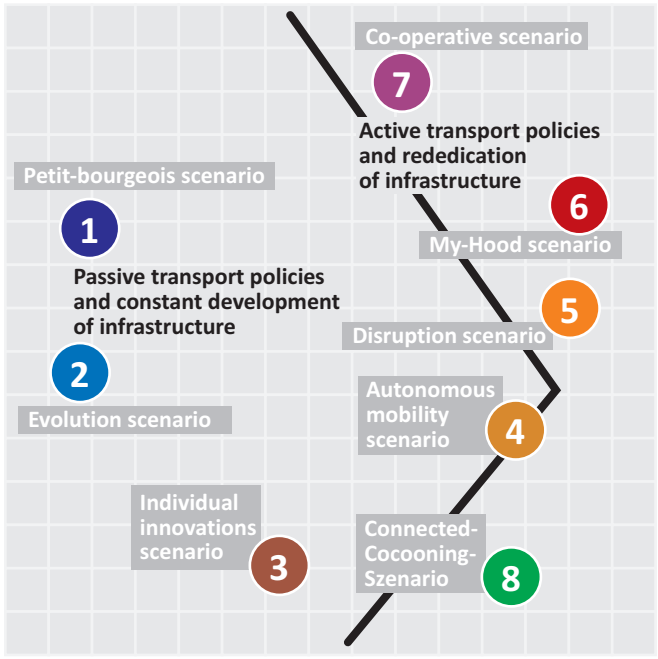
Will we still own cars in the future?

While many vehicles will still be privately owned in the urban areas of the first three future scenarios, the use of private vehicles will be severely restricted in city centers in scenarios 4 to 8. Delivery traffic will also face much more regulation than it does today.



How will cities control traffic flow in the future?

While in scenarios 1 to 3 the cities shy away from overly restrictive measures, scenario 4 already shows a change. We see major changes in scenarios 5 to 8, in which the cities actively control the flow of traffic and redesign roads rather than build new ones.

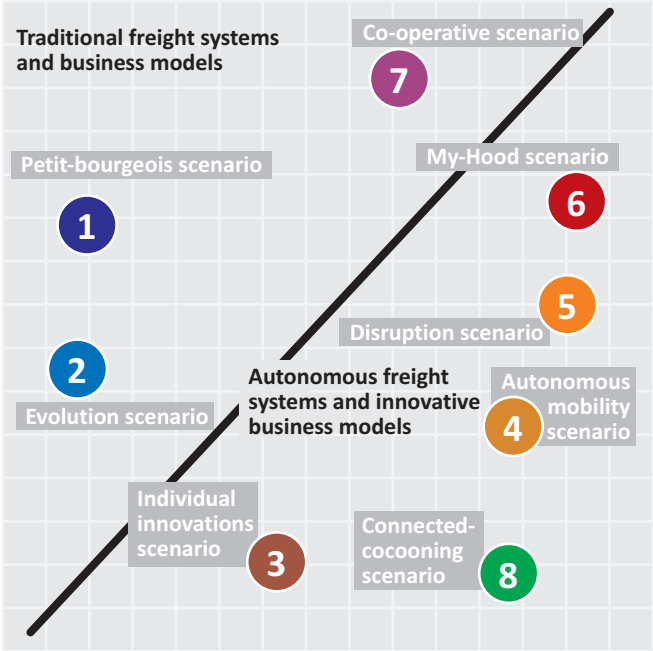


Will we still be in charge of driving in 2040?

In scenarios 1, 2, 3 and 7, people will continue to move through cities primarily with self-propelled vehicles – autonomous transport and micro-mobility services are merely additions to the overall transport system. The other four scenarios describe autonomous traffic worlds in which self-driving is increasingly out of fashion. In addition, a variety of new mobility systems such as micro-traffic exist as well as the ongoing conquest of the »third dimension«, air, takes place.

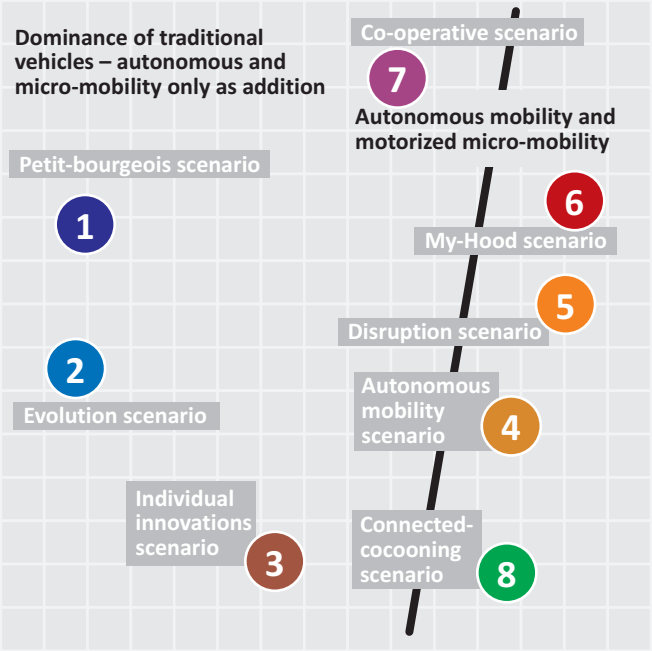
What will the freight transport system of the future look like?

A specific view emerges if we consider the common features of the three scenarios 1, 2 and 7. Here, freight traffic will remain constant, while in freight traffic, automation, driverless systems and completely new business models will establish themselves in scenario 3 and especially in scenarios 4, 5, 6 and 8.



Traditional, transformative and new mobility worlds

On closer examination of the differences and similarities – as presented in the upper graphic on the right-hand side – the eight scenarios can be clustered into three distinct mobility worlds. Scenarios 1 and 2 show a focus on already existing technologies ans systems. These two scenarios thus present a traditional view on mobility. On the other hand, there are the new mobility worlds of scenarios 5, 6 and 8. In each of these scenarios, all relevant changes come together: integrated services and the move away from private ownership, new engine systems and autonomous driving in passenger and freight transport, and a clear move away from private transport in the design of urban infrastructures. However, the answers to the challenges of urban mobility differ in the individual scenarios. The solutions vary between technological disruption (scenarios 5 and 6), a decline in mobility (scenarios 6 and 8) and regulatory and social changes in dealing with mobility.

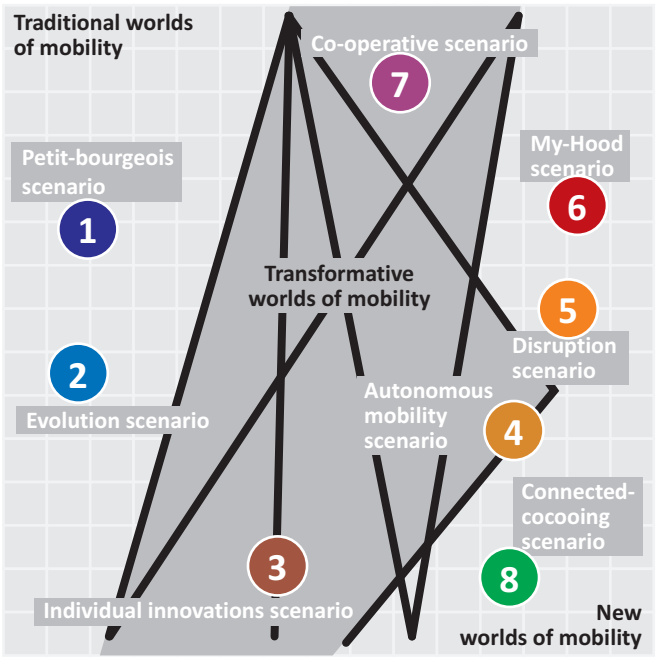


»Willy Brandt once said, ‚The best way to predict the future is to shape it.' Today, the world is complex and many actors are trying to change it according to their wishes. Making possible different futures tangible in scenarios based on expert assessments is the strength of ScMI's model – an intensive but structured approach based on multivariate, computational model-based analysis methods.

Expert judgements are influenced by the here and now. However, ScMI's meta-analyses on the topic of mobility showed a certain consistency over the years and different expert groups. As a regional industry developer and innovation consultant, these results are therefore more reliable orientation aids for the orientation of my work priorities than inclination – and wishful thinking oriented fortune telling. I have learned a lot from and with the interdisciplinary team – and I'm looking forward to learning again!«

Gernot Hagemann

hannoverimpuls GmbH



Between these two extreme images there are transformative mobility pictures of the future which differ greatly. Scenario 3, for example, relies heavily on a variety of innovations to make individual transport compatible with urban areas. Scenario 7, on the other hand, represents a future in which new collective transport systems will replace private transport in many situations. Scenario 4 with its focus on automated transport is also one of the transformative scenarios.

»Petit-bourgeois scenario or rather My-Hood? I know exactly which scenario represents a desirable future for my personal life situation. The highly structured approach of SCMI and the cross-industry cooperation within the project provides an excellent starting point for the question of what further development possibilities are conceivable in urban mobility, with all its opportunities and risks for trade and industry, old and new providers of mobility services, as well as social and political actors.«

Pia Leimbach

REWE Group

»'How is the mobility of people and goods developing, what influence do new working and living environments or consumer behavior have and what drives these influences? And what effects and opportunities does this create for your company?' Almost all companies in Germany are currently dealing with these questions, and so we have met with enormous interest in our interdisciplinary and cross-sectoral scenario study when searching for participants. The heterogeneous group of participants led to very exciting discussions and results.

I personally find it very helpful for my further mobility analyses that we have mapped the main factors influencing mobility. This makes it possible to systematically monitor mobility changes and their effects and to quickly detect and react to decisive changes. By using the ScMI methodology to depict all alternative scenarios, it is possible to keep an eye on everything that could be decisive for mobility developments. In my opinion, this is the perfect method to be always up to date in the product strategy and to be able to react correctly, combined with the enrichment through the heterogeneous participants and the group dynamics.«

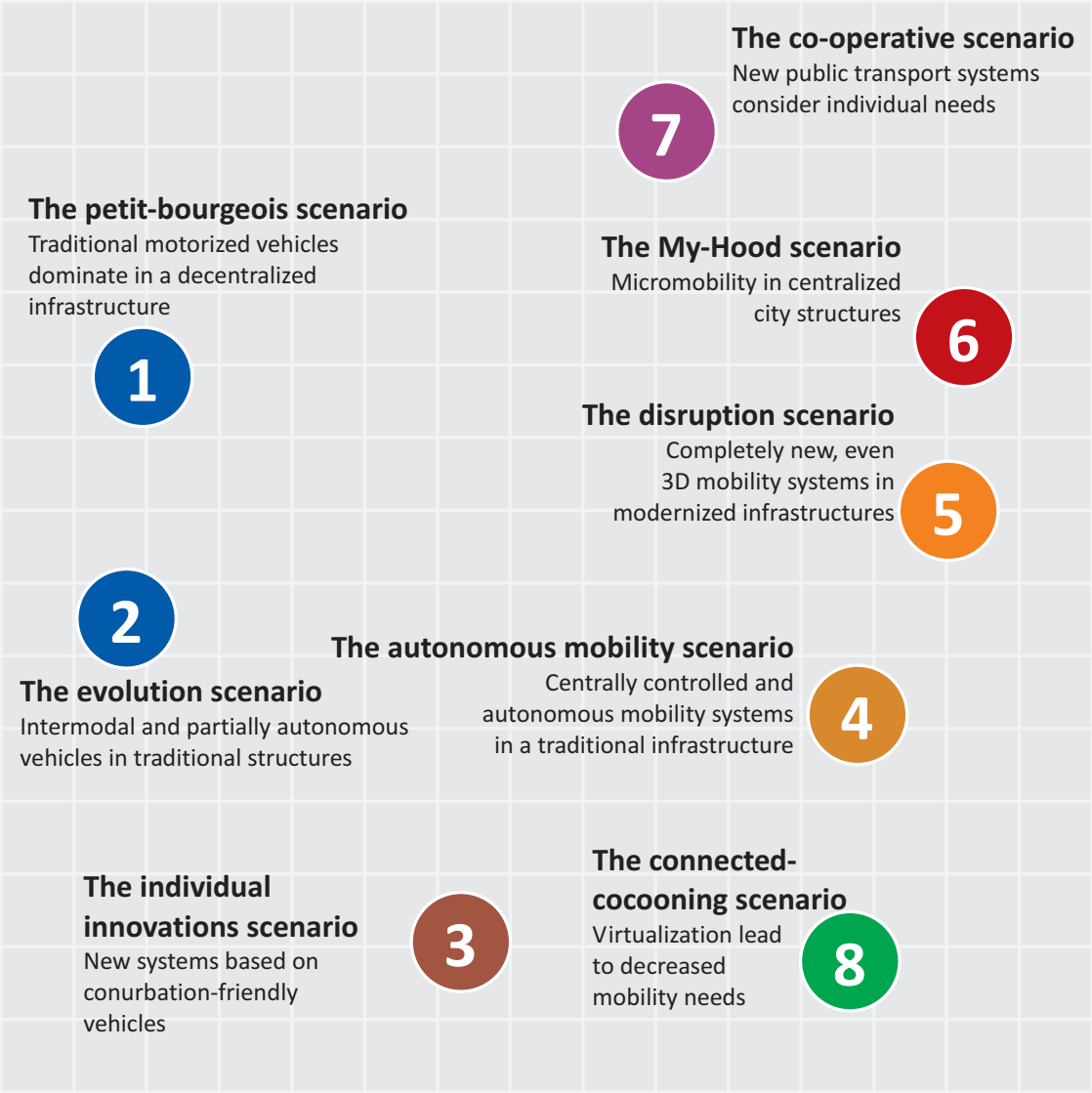
Gudrun Kneißl

Effisence

What scenarios arise from the mapping?

The eight scenarios can be classified and described on the basis of the core dimensions and the classification into the three mobility worlds:

- Scenario 1 (»the petit-bourgeois scenario«) describes the dominance of the classic MIV in decentralised conurbations having to meet the expectations of a technologically sceptical and divided society.
- Scenario 2 (»the evolution scenario«) also includes traditional mobility technologies and established transport infrastructure, but also evolutionary changes towards intermodal and semi-autonomous mobility services.
- Scenario 3 (»the individual innovations scenario«) shows a significant further development of MIV with all the components that the technology provides. Everything becomes smart and interactive, leading to optimized



traffic flows. This way, individual traffic is able to keep its dominance even in highly frequented areas.

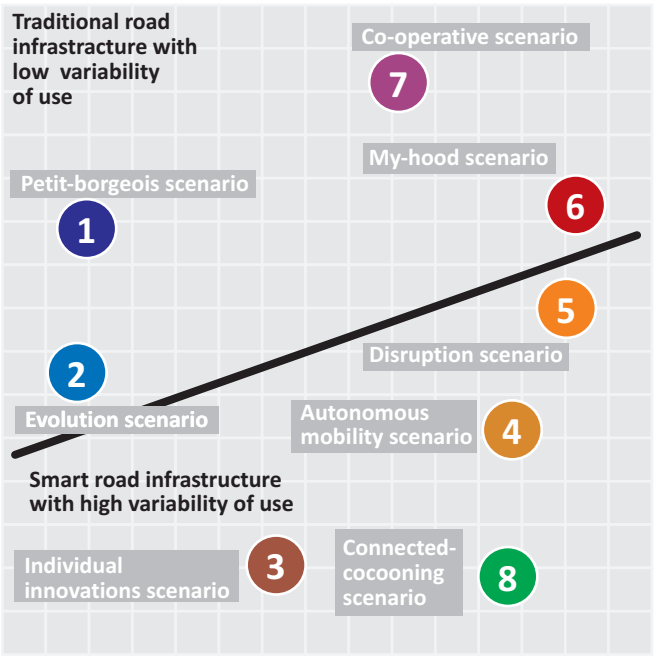
- Scenario 4 (»the autonomous mobility scenario«) already shows its special feature in the title: Within existing infrastructures, all traffic – from cars to collective transport and even to delivery traffic – becomes fully autonomous and thus even functions in the strictly regulated cities.
- Scenario 5 (»the disruption scenario«) describes a complete and drastic change in today's mobility world, which is supported and driven forward by politics and society. Traffic redistributes itself, is driven and motorized in different and new ways and even includes to a large extent air traffic.
- Scenario 6 (»the My-Hood scenario«) also includes major changes, although these are different from the ones described in scenario 5, the disruptions scenario. Urban structures and mobility events change, and new micromobility solutions are often used to cover the shorter distances.
- Scenario 7 (»the co-operative scenario«) focuses on efficient collective transport, which has, however, developed massively compared to the current standard. An efficient and sustainable transport system is created through strong regulation, society's drastic new thinking as a whole and orientation towards the individual needs of users.
- Scenario 8 (»the connected-cocooning scenario«) represents a world in which widespread virtualization leads to an overall decline in mobility. The post-materialistic society follows the politically predetermined path, as people can substitute many real encounters thanks to modern virtual realities and thus do not feel as if missing out.

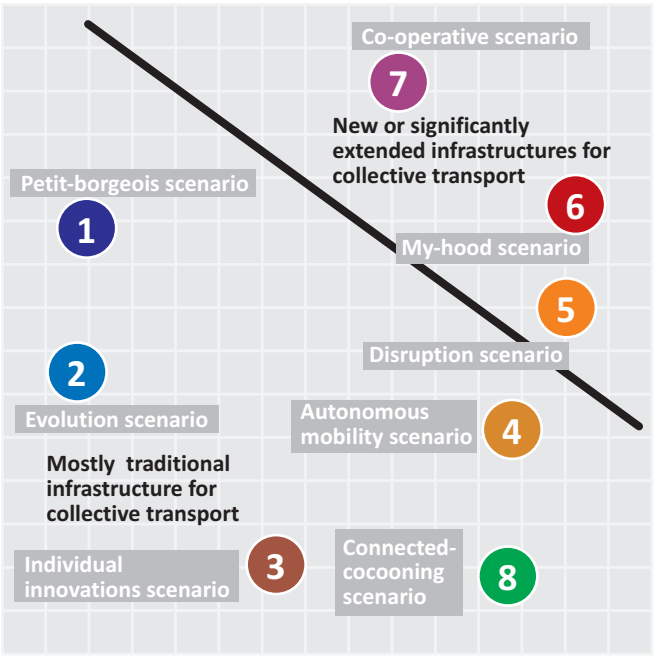
How is the mobility infrastructure developing?

It is noteworthy to describe that the mobility infrastructure is developing quite differently in the six transformative and new mobility worlds. The following two maps illustrate the scenarios in which a smart road infrastructure or new or significantly expanded infrastructure for collective transport will develop.

The summary of these two representations shows how the mobility infrastructure as a whole could develop:

- Scenarios 1 and 2 do not lead to significant changes in the mobility infrastructure – however, in the petit-bourgeois scenario, there is a renaissance of the traditional





»Everyone is talking about the mobility of the future. There is currently a lot going on in the mobility market, both regional and international. Large car manufacturers are increasingly developing into mobility service providers, new start-ups – pushed by financial investors worth billions – are entering the mobility market. We are currently experiencing the development of future mobility through the influence of the four major trends ‚electric mobility, digital networking, sharing and autonomous driving'. One would think that each of us has a clear picture in mind of what the mobility of the future will look like in twenty years' time. But what exactly will the road ahead present us with? What development directions will we see up to 2040?

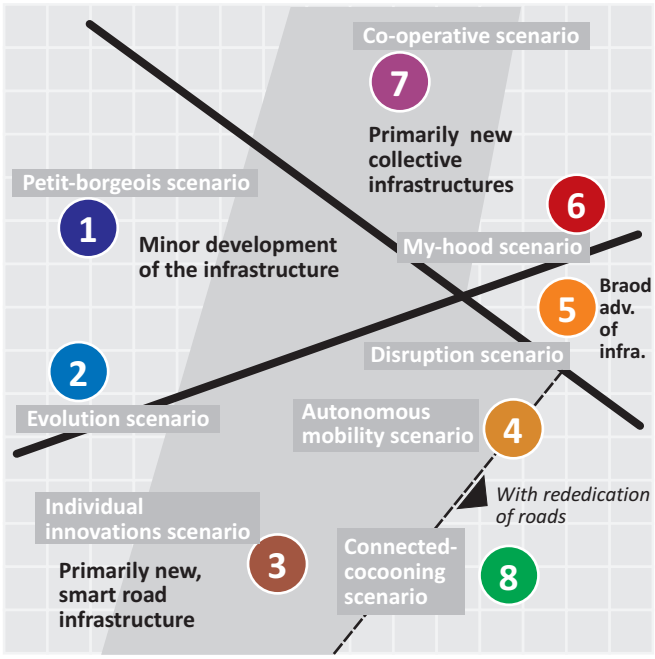
In contrast to other studies, this scenario analysis looks at more than the mere derivation and description of individual scenarios. The mobility map of the future puts these scenarios into a precise context and thus describes so much more than just ‚one true future'. The results are certainly exciting and insightful for many readers. It was therefore a pleasure for me to be able to develop this study together with the interdisciplinary scenario team.«

Alexander Hintze

Deutsche Bahn Connect GmbH

road, whereas the evolution scenario contains a more stagnant picture. This way, scenario 1 is even more traditional than what we expect from today's infrastructure.

- In scenarios 3, 4 and 8 there is always a smart road infrastructure developed, although in the connected-cocooning scenario (and to some extent also in the autonomous mobility scenario), this change is associated with a renaissance of the traditional road infrastructure.
- Scenarios 6 and 7 paint the opposite picture, with changes occurring primarily through new collective transport infrastructure. In the My-Hood scenario, this includes to a large extent micro-traffic due to the decreased mobility distances.
- In scenario 5, the disruption is linked to a broad-based further development of infrastructures - including urban air traffic.



Scenario 1:

The petit-bourgeois scenario

The tried and tested is preserved – traditional mobility supply completely meets the expectations of the population. On the other hand, innovations are regarded with mistrust; stagnation and inactivity are perceived as positive signals of security. At the same time, city centers are losing importance, so that the use of private, motorized vehicles is not only possible in many places, but also regarded as necessary. Accordingly, there is hardly any investment in infrastructure restructuring. For mobility providers, this means that there is hardly any pressure to innovate. Thus, new mobility models receive little attention and play a subordinate role.

Safety instead of innovation

The difficult economic situation lies heavy on large parts of society. With an increasing economic divide, many people's everyday security is diminishing, and with it their willingness to embrace new ideas. As a result, the entire economic and social environment loses confidence in progress and innovation. Change is widely perceived as a threat: one prefers to hold on to what has been tried and tested and is supporting one's individual advantage.

No trace of a turnaround in mobility

The widespread fatigue of change in mobility issues meets the wish of the population to be able to continue to move freely and independently. For this reason, changes in the mobility system are viewed particularly critically - especially when they restrict personal mobility. For example, progressive automation of driving fails because of the low level of technology acceptance. In order to maintain personal mobility, simple and inexpensive means of transportation are preferred. In addition, politicians show little creative power in order to meet this problematic environment and civil initiatives often lead nowhere.

The end of urbanization

With social regression, urban spaces are losing their leading function. Cities and areas of agglomeration have an overall weak position and can hardly set their own political agenda. The dwindling attractiveness of cities leads to more and

more departures from the once celebrated big city life. As a result, the burden on metropolitan areas does not increase any further and traffic regulates itself although infrastructures are only partially modernized.

Repair work on the »car-friendly city«

Investments in infrastructure will continue to be made with a focus on motorized private transport. This way, the growing suburbs and medium-sized centers are further linked with the agglomerated urban areas. However, innovation in traffic control remains stuck. The »car-friendly city« is not yet obsolete, but is being adapted to the changing framework conditions. This applies not only to passenger transport but also to traditional freight transport and distribution systems. As a consequence, other infrastructures are left behind and new concepts, which traditionally tend to emerge in urban areas, can only rarely unfold.

Existing mobility offers are sufficient

Compared to today, the modes of transportation in urban areas have changed only moderately. Individual private vehicles continue to shape the image of cities: collective transport is not growing significantly, micro mobility is hardly promoted and remains rather a marginal phenomenon, and air traffic via drones plays no role at all. Even passenger car concepts are not changing fundamentally - autonomous driving, the improved usage of commute times as well as radically new interior concepts are proving to impossible to finance under the general conditions. Even combustion engines have not disappeared from the cityscape, but continue to form urban mobility on the basis of moderate innovations and rather stagnating environmental standards. New mobility service providers are hardly established, as the opportunities and markets for new business models are very limited. In return, new vehicle manufacturers with simple car concepts are able to establish themselves.

Population remains mobile

The actual mobility behavior hardly changes. Social activities continue to enjoy a high status in the urban way of life and thus lead to a preservation of the existing traffic volumes. In particular, private motorized vehicles will continue to be used above all – on the way to work as well as for consumption and leisure activities. The population appreciates the preservation of the status quo concerning the infrastructure, as this proven mobility is regarded as safe and therefore trustworthy.

Analogous to the given consumer behavior, classic freight transport continues to play an important role. The overall increase in the volume of mobility is accompanied by the expansion of traditional infrastructures. However, the mobility volume resulting from individual and freight traffic also has its downsides. Both private and freight transport within cities have a negative impact on the environmental quality, in particular on air quality. In addition, increasing noise pollution also affects life in urbanized areas and makes it less attractive.

End of Centre of Innovation »Future Mobility«

22 years of innovative research for tomorrow's mobility have led nowhere: the Centre for Mobility Innovation will close at the end of this month. The reasons cited include the low level of public interest and the lack of political and economic support.

When the ceremonial opening of the »Future Mobility« Innovation Centre took place in August 2018, illustrious figures from politics and business were present. It was supposed to be the starting signal for Germany's expansion into a country of mobility innovations. As the Managing Director, Mr. Michael von Morgen, proudly announced, the Innovation Centre was planned as an »oasis for visionaries and engineers in which mobility, whether for individual vehicles or entire infrastructures, will be rethought«. From the very beginning, research was conducted in areas of alternative drive systems, but also in the automation and networking of mobility offerings.

However, the general euphoria was quickly followed by disillusionment. In particular, a traffic accident with an automated vehicle that claimed two lives caused general horror among the population. Statements by engineers that such incidents could occur at some point in the development of automated systems led to nationwide protests and a deep distrust of the technologies used. But the weakening trend towards the centralization of conurbations also put a stop to the innovators. »The general population is not aware of any need for innovative forms of mobility, and the economy is of course moving with it,« says Mr. von Morgen, shaking his head. »Nobody thinks about the environmental consequences of private motorised vehicles. Not even the politicians, who stopped their support years ago.« Because of this lack of support, including financial one, the Innovation Centre will close its doors at the end of this month.

Where we can observe the petit-bourgeois scenario today:

City traffic in Los Angeles

Today the car is by far the preferred mean of transport in Los Angeles. 80 % of passenger kilometers are travelled by car. According to LA2B.ORG, an organisation stimulating a dialogue about traffic development in Los Angeles, 65.7 % of the trips take place in a „solo car" - i.e. alone or at most shared with family or friends. Carsharing, whether private or commercial, accounts for 15 % of the total. The remaining 20 % of the distances are divided between public transports (about 10 %) and only the smallest shares remain for bicycles, pedestrians and other alternatives. In other words, in L.A., you drive from A to B in your own car. This is certainly primarily due to the specifics of the city: the entire city consists of a mosaic of individual city districts, which are very different both functionally and in their social structures. This fragmented structure leads with an average of 19 miles in one direction to very long commuter routes, which are preferably covered by car. This is due to the fact that in the region with the highest traffic density in the world, people often get stuck in traffic jams, but public transport does not offer real alternatives. L.A. was built with 6,500 miles of public roads and almost 200 miles of freeway. On the other hand, even after the current expansion, there are less than 100 miles of rail network for public transport. Due to the urban sprawl, busses are not really attractive, as the nearest bus stop is seldom within walking distance. In citizen dialogues, the city tries to get commuters to at least carpool and gives priority to cars with three or more people on »Carpool Lanes«. However, a complete change in traffic planning away from motorized individual transport towards alternatives is not foreseeable.

Strategic Consequences

Manufacturers and OEMs

OEMs only need to innovate for meeting laws in order to keep their market position.

High importance of marketing and brand development, since manufacturers have no other options to differentiate.

Low importance of specific vehicles for urban areas.

Public transport providers

Focus on efficiency instead of innovation.

Standardized transport sizes are to be offered for a large population and low tariffs.

A central question is how public transport providers can be developed in rural areas.

Logistics providers

Mostly constant systems for goods and their distribution.

Optimizing the transportation of goods is a matter of competition levels and margins.

New business models are less developed from urban centres, but from decentral structures.

Industry and trade

Supply and experience consumption continues to take place in physical spaces.

The production of goods is primarily based on available spaces in the extended urban areas.

Technology providers

Technology providers can gain a foothold in the market where their technology is aimed at improving individual traffic - i.e. less in infrastructure and collective traffic control.

Mobility services provider

Due to fierce competition for a few customers, mobility service providers must above all offer simple products at low prices (basic needs).

Cities and city planners

Continued massive investment in road infrastructure to optimise the existing transport network in order to maintain the status quo in the future and avoid traffic collapse.

Surrounding rural regions

The growth of conurbations (road infrastructure, building land, etc.) requires the exploitation of new land.

New integrated traffic development planning with a focus on rural area networks.

Citizens and consumers

Increase in noise and emissions (environmental pollution) due to continued increase in motorized individual vehicles.

Traffic jams due to increased traffic on the one hand and construction sites on the other.

Economic and techno-logical environment	Broad economic participation but data is gathered by only few	Broad economic and technological participation	**Economic split of the society and focus of the data in a few hands**	Restrained economic development – but broad availability of data	
Technology acceptance and understanding	Inspite of low technology acceptance, plays AI a major role in mobility sector	New technologies incl. AI are broadly accepted and used in mobility sector	**Due to low technology acceptance, AI is not used in mobility sector**	High technology acceptance, but no use of AI in mobility sector	
Environmental policy	Low environmental quality inspite of high influence of environmental policies	Strong influence of environmental policies leads to high environmental quality	**Despite low environmental quality in cities, environmental policies do not have a great significance**	High environmental quality in cities inspite of low influence of environmental policies	
Lifestyle / Leisure behavior	Virtual social interactions shape the urban lifestyle	Urban lifestyle is shaped by both physical and virtual interactions	Overall reduced personal interactions (New Cocooning)	**Real social interactions shape the urban lifestyle**	
Consumption and shopping behavior	Shopping behavior stays the same, groceries will be delivered	**Both leisure and grocery shopping lead to high personal mobility**	Low personal mobility: shopping takes entirely place virtually	Virtual leisure shopping, real shopping for groceries	Radical changes in consumption behavior: decreasing mobility
Individual mobility needs	Decreasing need for mobilty – demand for high-level services	Strong demand for high-level mobility services	Decreasing need for mobilty – demand for simple services	**Strong demand for simple mobility services**	Mobility as scarce luxury service
Use of mobility phases	Usage of mobility phases leads to significant changes in mobility behavior	Usage of mobility phases has significant influence on chosen means of transport	**Mobility phases are not used differently**	Moblity phases are used differently, but do not influence mobility decisions	
General transportation policies	Strong regulation adapted on consequences for mobility: relinquishment	Adaptation on efficiency: stimulation of technology with sustainable goals	**Weak general transportation policies: passive politics**	Technological support for innovations: focus on growth and creation of workforce	
Drive systems	Electro mobility dominates urban drive systems	Diverse low-emission drive systems, including hydrogen and hybrids	**Combustion engines are still dominating urban drive systems**	Maximum diversity of drive systems in urban areas	
Autonomous vehicles	Classic and new autonomous vehicles coexist	Autonomous driving leads to new car models and mobility concepts	Evolutionary addition of mobility concepts by autonomous vehicles	Autonomous driving becomes dominant concept in traditional surrounding	**Autonomous driving only takes place in niches**
Urban development / Urbanization	**Massive decentralization: Work and life take place outside of cities**	Decentral work environments lead to traffic jams	Decentralized living leads to mobility peaks into cities for work	Centralized cities: short mobility distances, tendency towards micro-mobility	Virtualization of life and decreasing compulsory mobility
Role, power, and identity of cities	Cities use their powerful position for their own agenda	Strong and active role of cities in both politics and economy	**Overall weak position of cities in both politics and economy**	Cities follow set political agenda, but are economically independent	
Car usage	Private and alternative usage takes place parallely – in both urban and rural areas	Broad substitution of private cars in urban areas	**Individual mobility in urban areas is largely characterized by private cars**	Strutural changes: private cars are replaced in urban, but not in rural areas	
Urban road infrastructure	Variable and increasingly smart infrastructure	Intelligent infrastructure including reallocation for variable usage	Maintenance of traditional infrastructure	Significant reduction of infrastructure, for micro and collective mobilty	Worsening of infrastructure due to missing investments
Freight transport and distibution systems	Strong regulation of an only partly automated freight and distribution system	Strong regulation of a highly automated freight and distribution system	**Mostly constant freight and distribution system**	Strongly automated freight and distribution system without significant regulation	
Traffic management systems	Active traffic management in limited systems	Active traffic management in broad systems	**Passive traffic management in limited systems**	Passive traffic management in broad systems	
Vehicle manufacturers	**New manufacturers drive traditional manufacturers out**	New manufacturers revolutionize mobility market with new business models	Traditional manufacturers dominate mobility market	Traditional manufacturers dominate mobility market with business models	
Vehicle concepts in urban areas	Conurbation tolerance as primary driver for new vehicle concepts	Conurbation tolerance AND interior usage as driver for new vehicle concepts	**Dominance of traditional vehicle concepts**	Enhanced interior usage and design as primary driver for new vehicle concepts	
Freight vehicles in urban areas	Traditional driver-focused vehicles are designed more conurbation-friendly	Conurbation-friendly design of new, driverless freight vehicles	**Mostly traditional freight vehicles**	Optimization of freight transport by automatic and driverless vehicles	
Collective transportation	New CT focused on individual needs in existing infrastructure	New CT focused on individual needs in new infrastructure	Evolutionary further development of existing infrastructure	New infrastructure for individual CT based on traditional vehicle sizes	Continuing dominance of classic collective systems
Micro-mobility	Micro-mobility equiped with engines	Broad usage of micro-mobility – with and without engine	**Low relevance of micro-mobility**	Micro-mobility mostly without engine	
Air traffic in urban areas	Air traffic only for freight transport	Air traffic for both passenger and freight transport	**Air traffic does not play a significant role**	Air traffic only for passenger transport	Broad implmentation of air traffic
Integrated mobility services	Passengers only use broad services in special cases	Passengers subscribe long-time to overall services	Passengers only use singular services in special cases	Passengers subscribe to one or only few special services	**Mobility services only play a minor role**
Modal split for passenger transportation	Broad network of different modes	Classic collective transportation dominates	**Classic individual transportation dominates**	New mobility concepts arise	Significant reduction of mobility needs
Modal split for freight traffic	Supraregional classic traffic – new concepts only in city centers	**Overall high imoprtance of freight transport in urban areas**	New freight systems – classic transport loses importance	Freight transport in city centers – other concepts only supraregional	Significant decrease of freight transport

Characteristic projection *Partly characteristic projection* *Unique projection* *Alternative projection*

Scenario 2:

The evolution scenario

Everything remains as it is today – only better. The population of metropolitan areas attaches great importance to mobility and its required investment of time. The resulting higher willingness to pay means that the convenience demands of mobility customers are the main driver of innovations in the mobility sector. The private sector in particular is benefiting from this. Politicians lack the necessary willingness to shape the future; due to the subordinate position of metropolitan areas, no new infrastructure models can be implemented. By adhering to the existing spatial concepts, innovations are limited.

Lack of policies provides economic opportunities

Traditional mobility concepts are being retained, even if their limitations become apparent and customers would wish for changes in many areas. Given the appropriate financial means, the corresponding services can already be partly purchased. The resulting division of social groups is directly reflected in infrastructural design. General policy lacks the will to oppose individual interests with new, comprehensive concepts. This is exemplified by the low level of environmental orientation despite its poor quality. The objectives pursued by the economy, politics and single industries are often contradictory to each other. Due to these politically adverse framework conditions, innovations targeting an increase in the common good are hardly pursued – instead, incremental innovations arise that are designed privately to meet the wishes of individual customers. In this environment, traditional vehicle manufacturers continue to have an open market access without having to fear new competitors. By supplementing existing vehicle concepts with new technologies and an increased focus on comfort, the existing willingness to pay for high-quality mobility concepts can be profitably reaped.

Traditional infrastructure remains unchanged

Urban areas barely have their own political freedom and effectiveness and thus cannot directly influence transport

policy designs. There is therefore a lack of resources for a comprehensive reorganization of mobility within metropolitan areas. Instead, the existing infrastructure is retained. There is a need for compatibility of mobility innovations within these existing infrastructures. Nevertheless, the automation of freight transport, driven by private-sector interests, creates more space on the roads - and individual vehicles based on new concepts are becoming more environmentally friendly and compatible with metropolitan areas.

Individuality and time optimization dictate the range of mobility

Mobility offers continue to be characterized by traditional modes and concepts of transportation. However, there are functional extensions that complement existing structures in an evolutionary way. These are oriented towards the needs of customers and aim primarily at the improvement of the use of vehicle interiors. Those who can afford it rely on their private vehicle, which, thanks to the use of artificial intelligence, can move completely or partially autonomously on the classic road infrastructure. Despite this dominance of private transport, public transport services are also being partly renewed – here, too, the importance of luxury mobility offers is evident. Collective transport systems, for example, are oriented more closely to individual needs. In addition, individual and collective transport systems are more interconnected. Accordingly, traditional mobility services exist parallel to innovative solutions. The clear restriction on services driven by convenience results from traditional, rigid infrastructures – a disruptive turnaround in mobility is thus prevented.

Demand for mobility remains high

Mobility behavior is significantly influenced by the increasing of individual needs of the urban population. Great importance is still attached to real social interaction. Both shopping for supplies and shopping as an experience are also often done personally in physical stores. Thus, the resulting mobility times should, however, be arranged in a convenient way. Many people wish to spend this time with other activities. The individual benefit optimization - in combination with the corresponding willingness to pay - becomes the driver of change. This desire for comfortable, individual mobility solutions is therefore driven by selfish motives, so that the population is not interested in the effects on the environment. The general welfare of society is therefore also pushed into the background as a motivation for improved mobility organization.

Autonomous driving with potholes

Johannes Müller smiles contentedly as he lets himself sink into the buttery-soft leather seat of his limousine. He confirms with a short nod the alternative route due to traffic jams suggested by the friendly voice of the driving system. He hasn‘t regretted buying this car for a second, as he can now relax and drink his coffee while driving to work – the car takes care of driving itself. Although Mr. Müller still has to sit behind the wheel, he trusts the technology so much that he likes to tie his tie and shine his shoes briefly while driving. After all, he is on the board of the company that is responsible for the artificial intelligence operation technology behind most semi-autonomous cars. The great demand from the OEMs has provided the medium-sized company from Germany with full books for the next few years, so he really can‘t complain about the hefty price of his car.

Mr. Müller shakes his head compassionately as his car foresightedly avoids a full bus. Although public transport systems have become more comfortable, he still believes that politicians are doing far too little to turn mobility around. In keeping with this gloomy thought, the bus next to him emits a thick cloud of exhaust fumes. Mr. Müller can understand all the envious glances that he and his top car encounter every day. Especially for his employees, he is sorry that they cannot afford such a luxury with their actually quite good salary. And it also annoys him for his company. How excellent it would be if all public transport operators worked with him alongside the latest vehicle models!

Just at this moment, Mr. Müller pours his hot coffee over his fresh shirt as his car suddenly rumbles through a pothole. Annoyed, he tries to wipe away the stain with the back of his tie. »This town doesn‘t care about anything,« he mumbles, ill-humoured and ponders how cars can react better to potholes in the future. If nobody eliminates these holes, the economy has to find a way around them.

Where we can observe the evolution scenario already today:

Waymo: Autonomous driving today

The company Waymo, which was founded in 2016 as a subsidiary of the parent company Alphabet, continues the research of the Google »Driverless Car«. The aim is to develop marketable, autonomous vehicles that enable people and objects to move easily and safely. The need is present, because although private transport remains the preferred mean of transport, people's demand for convenience is increasing. They want to use their time during the drive more efficiently and are therefore prepared to pay higher prices for autonomous vehicles. The vehicles are equipped with software and a 360° camera mounted on the roof of the vehicle, which is supposed to predict the movements of road users. A very precise distinction can be made between a pedestrian, a cyclist and other mobile vehicles. By the end of 2018, a total of 16 million kilometers on public roads and 11 million kilometers in simulation facilities had been driven using this technology, which was previously integrated into various vehicle types. What was learned during these test drives served as the basis for the first fully autonomous taxi fleet in Arizona as early as 2017. Since then, 400 passengers have been taken to their destination every day by the driverless vans. The expansion to Europe follows. Currently, the vehicles are only driven on closed test tracks. However, this will change in the not too distant future if the legal requirements are met.

Strategic consequences

Manufacturers and OEMs

Evolutionary expanded sales potential for existing vehicle concepts.

AI and autonomous driving allow for improved use of mobility time.

New sales potential in the areas of individualisation, comfort and interior usage possibilities.

New drive concepts not absolutely necessary, but rather complementary.

Public transport providers

In line with the modal split, the networking of the individual mobility offers is becoming increasingly important.

Integration of public transport into networked mobility offers.

Equipment, comfort and possibilities during the journey are decisive factors for the choice of transport mode (increasing competition with each other).

Logistics providers

Traditional concepts continue to determine the range of products on offer.

Technology and efficiency-driven development.

Industry and trade

No structural changes: Dominance of stationary retail and presence-based work.

Industry and trade are still as relevant as today and are traditionally supplied.

Technology providers

Broad spectrum of new technologies.

Strong demand for technologies for the varied usage of mobility times.

Environmental technologies for securing individual transport.

Mobility services provider

Slow development of the market for mobility services.

Due to fierce competition for a small number of customers, mobility service providers have to offer mainly simple products.

Cities and city planners

Investments primarily to maintain existing infrastructure, focus on connecting the busy city centres.

Safeguarding the quality of the environment in the face of increasing pollution to enable growth.

Surrounding rural regions

Little change from the current situation.

Especially from the point of view of the surrounding area, a connection to the growing conurbations is necessary. Multimodal approaches are becoming more important.

Citizens and consumers

Dominance of selfish behaviour to satisfy individual needs.

Little consideration of environmental aspects; therefore, politics and companies are the most important players.

Economic and techno-logical environment	Broad economic participation but data is gathered by only few	Broad economic and technological participation	Economic split of the society and focus of the data in a few hands	Restrained economic development – but broad availability of data	
Technology acceptance and understanding	Inspite of low technology acceptance, plays AI a major role in mobility sector	New technologies incl. AI are broadly accepted and used in mobility sector	Due to low technology acceptance, AI is not used in mobility sector	High technology acceptance, but no use of AI in mobility sector	
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Lifestyle / Leisure behavior	Virtual social interactions shape the urban lifestyle	Urban lifestyle is shaped by both physical and virtual interactions	Overall reduced personal interactions (New Cocooning)	Real social interactions shape the urban lifestyle	
Consumption and shopping behavior	Shopping behavior stays the same, groceries will be delivered	Both leisure and grocery shopping lead to high personal mobility	Low personal mobility: shopping takes entirely place virtually	Virtual leisure shopping, real shopping for groceries	Radical changes in consumption behavior: decreasing mobility
Individual mobility needs	Decreasing need for mobilty – demand for high-level services	Strong demand for high-level mobility services	Decreasing need for mobilty – demand for simple services	Strong demand for simple mobility services	Mobility as scarce luxury service
Use of mobility phases	Usage of mobility phases leads to significant changes in mobility behavior	Usage of mobility phases has significant influence on chosen means of transport	Mobility phases are not used differently	Moblity phases are used differently, but do not influence mobility decisions	
General transportation policies	Strong regulation adapted on consequences for mobility: relinquishment	Adaptation on efficiency: stimulation of technology with sustainable goals	Weak general transportation policies: passive politics	Technological support for innovations: focus on growth and creation of workforce	
Drive systems	Electro mobility dominates urban drive systems	Diverse low-emission drive systems, including hydrogen and hybrids	Combustion engines are still dominating urban drive systems	Maximum diversity of drive systems in urban areas	
Autonomous vehicles	Classic and new autonomous vehicles coexist	Autonomous driving leads to new car models and mobility concepts	Evolutionary addition of mobility concepts by autonomous vehicles	Autonomous driving becomes dominant concept in traditional surrounding	Autonomous driving only takes place in niches
Urban development / Urbanization	Massive decentralization: Work and life take place outside of cities	Decentral work environments lead to traffic jams	Decentralized living leads to mobility peaks into cities for work	Centralized cities: short mobility distances, tendency towards micro-mobility	Virtualization of life and decreasing compulsory mobility
Role, power, and identity of cities	Cities use their powerful position for their own agenda	Strong and active role of cities in both politics and economy	Overall weak position of cities in both politics and economy	Cities follow set political agenda, but are economically independent	
Car usage	Private and alternative usage takes place parallely – in both urban and rural areas	Broad substitution of private cars in urban areas	Individual mobility in urban areas is largely characterized by private cars	Strutural changes: private cars are replaced in urban, but not in rural areas	
Urban road infrastructure	Variable and increasingly smart infrastructure	Intelligent infrastructure including reallocation for variable usage	Maintenance of traditional infrastructure	Significant reduction of infrastructure, for micro and collective mobilty	Worsening of infrastructure due to missing investments
Freight transport and distibution systems	Strong regulation of an only partly automated freight and distribution system	Strong regulation of a highly automated freight and distribution system	Mostly constant freight and distribution system	Strongly automated freight and distribution system without significant regulation	
Traffic management systems	Active traffic management in limited systems	Active traffic management in broad systems	Passive traffic management in limited systems	Passive traffic management in broad systems	
Vehicle manufacturers	New manufacturers drive traditional manufacturers out	New manufacturers revolutionize mobility market with new business models	Traditional manufacturers dominate mobility market	Traditional manufacturers dominate mobility market with business models	
Vehicle concepts in urban areas	Conurbation tolerance as primary driver for new vehicle concepts	Conurbation tolerance AND interior usage as driver for new vehicle concepts	Dominance of traditional vehicle concepts	Enhanced interior usage and design as primary driver for new vehicle concepts	
Freight vehicles in urban areas	Traditional driver-focused vehicles are designed more conurbation-friendly	Conurbation-friendly design of new, driverless freight vehicles	Mostly traditional freight vehicles	Optimization of freight transport by automatic and driverless vehicles	
Collective transportation	New CT focused on individual needs in existing infrastructure	New CT focused on individual needs in new infrastructure	Evolutionary further development of existing infrastructure	New infrastructure for individual CT based on traditional vehicle sizes	Continuing dominance of classic collective systems
Micro-mobility	Micro-mobility equiped with engines	Broad usage of micro-mobility – with and without engine	Low relevance of micro-mobility	Micro-mobility mostly without engine	
Air traffic in urban areas	Air traffic only for freight transport	Air traffic for both passenger and freight transport	Air traffic does not play a significant role	Air traffic only for passenger transport	Broad implmentation of air traffic
Integrated mobility services	Passengers only use broad services in special cases	Passengers subscribe long-time to overall services	Passengers only use singular services in special cases	Passengers subscribe to one or only few special services	Mobility services only play a minor role
Modal split for passenger transportation	Broad network of different modes	Classic collective transportation dominates	Classic individual transportation dominates	New mobility concepts arise	Significant reduction of mobility needs
Modal split for freight traffic	Supraregional classic traffic – new concepts only in city centers	Overall high imoprtance of freight transport in urban areas	New freight systems – classic transport loses importance	Freight transport in city centers – other concepts only supraregional	Significant decrease of freight transport

Characteristic projection *Partly characteristic projection* *Unique projection* *Alternative projection*

Scenario 3:

The individual innovations scenario

Technology as a driver of progress – this is how politics and society understand the development of urban mobility. The pressure to improve the given conditions has led to the parallel development of a wide variety of forms of mobility. In addition to increased automation, alternative drive systems and infrastructure developments are taking place – much to the delight of the users. Environmental quality can also be improved in this way. In addition to the opportunities for new business models arising in this innovative climate, the fragmentation of the mobility market is developing into a completely new challenge.

Innovations as problem solvers

The limitations of traditional mobility systems have become so obvious that transformation is inevitable. Politicians are increasingly arguing in favour of such a mobility shift. Particular attention is being paid to new technologies as a driving force for innovation. These are implemented with the help of higher-level regulation - local restrictions are avoided wherever possible. A major field of regulation is freight transport, which is becoming increasingly automated. Accordingly, there are numerous new fields of activity for classic mobility providers, which are stringently pursued due to the high willingness to pay. For the implementation of the technological requirements, partnerships are also entered with corresponding IT companies. Thus, the necessity for a redesign of urban mobility results in positive framework conditions.

Low differences between urban and rural areas

The cities' scope for shaping the future is rather limited by the active political framework. Thus, there are hardly any differences in mobility characteristics between urban and rural areas. In the city, however, the population benefits from the increasing environmental quality due to new tech-

nologies, which also promote alternative drive types. The automation of freight transport also creates more space on the roads - and individual vehicles based on new concepts are becoming increasingly compatible with urban areas.

Parallelism of several mobility concepts

The urban transport systems are characterized by parallel concepts and multimodality: the classic individual transport system known to us still exists. However, new concepts such as alternative types of propulsion and progressive automation are also creating more diversity on the roads. Thus, individual and autonomous traffic occur in parallel and are additionally supplemented by traditional and new collective transport systems. In this way, infrastructures must satisfy the requirements and special features of different concepts in parallel - especially at intersections, these diverse forms of mobility are supported and coordinated by active traffic control. This diversified passenger traffic is supplemented by large-scale automation of urban freight traffic. This leads to less traffic during rush hours on the roads, while at the same time new technologies and systems are lead to greater demands on the given infrastructure.

Mobility-enthusiastic population

Users continue to strive for high-end mobility services. There is an increased willingness to pay, especially for improved use of mobility times. And the need for mobility remains high: not only for work do people come to cities, real interactions are also desired in leisure time. In addition, shopping experiences in particular are perceived as a pleasant leisure activity, so that stationary retail continues to be preferred here. This understanding of mobility means that innovations are assessed positively and accepted with pleasure. New mobility services and innovative business models can thus quickly become established - with a wide variety of competing approaches. Even if there is a willingness to use public transport systems, mobility users concentrate on one or a few providers, which significantly intensifies competition. The modal split between individual transport and collective transport, e.g. through park-and-ride offers, is therefore of particular interest.

Hurray, we‘re still driving and shopping!

Änni Kahne is considered one of the most renowned architects in Europe. With her specialization in road concepts for the private sector, she meets the ravages of time. On the occasion of the opening of the new mall »Convenieso«, we met Mrs. Kahne for a short interview.

Interviewer: Dear Mrs. Kahne, your new and recently completed major project »Convenieso« is currently on everyone‘s lips. How do you achieve such exuberant reactions?

Änni Kahne: That‘s basically very simple. My work is strongly oriented towards the needs of the target group. Apparently more than my colleagues one (laughs).

I: Can you explain that in more detail?

ÄK: Well, it‘s really not that complicated. People love to go shopping in their free time and want to have as good a time as possible. But what many people don‘t take into account is that this also includes a comfortable journey and a sophisticated logistics concept.

I: How exactly did you implement this in the case of the new mall »Convenieso«?

ÄK: That‘s already in the title, my team and I were particularly interested in convenience. For a long time, mobility was a necessary evil, but thanks to new technologies, it is now fun again and does not burden either neighbours or the environment. It sounds so easy, but it means multiple innovations.

I: In what way?

ÄK: Well, the different types of mobility have to be connected to our mall as precisely as possible so that it remains comfortable for the customers and there are no complicated routes. And with all the different types of transportation systems, that‘s a big challenge. We have developed a special control system for automated cars, which also handles the necessary coordination with conventional cars. At the same time, we have set up several stations for collective transport of all kinds, depending on the provider and business model. The establishment of »modal split« zones, i.e. parking spaces for cars with direct connection to other systems, was also particularly important to us. In this way, we also intercept commuters as an additional customer group.

I: It all sounds very well thought out.

ÄK: (smiles) ... and we haven‘t even talked about the goods delivery system. It‘s fully automated and always on time, so that the latest products always find their way into the stores. And of course in such a way that the customer doesn‘t even notice. But that would really go beyond the scope of this interview, I‘m afraid...

Where we can observe the individual innovations scenario already today:

Sweden: Autonomous trucks

In cooperation with DB Schenker, the Swedish robot vehicle start-up Enride demonstrates that autonomous freight transport is possible. »T-Pod«, as the model was called, is the first fully automated robot truck in commercial use. It does not require a driver's cab, has an official road permit and can cover a distance of 200 kilometers per battery charge. The first test runs were started in November 2018. Since then, the T-Pod has been used in the Swedish province of Jönköping, where it connects two warehouses on the DB Schenker site. Cameras, infrared detectors, antennas and radar systems enable the truck to navigate safely. Legal requirements ensure a controlled and safe usage of the truck. The speed limit is five kilometers per hour - although the truck could easily reach ninety kilometers per hour - and the permanent supervision of an employee who can intervene by remote control in an emergency is mandatory. So far, only a small piece of public road of 100 meters between the warehouses has been integrated into the daily route of the T-Pod. In the future, and thanks to further improvements in technology, nothing will prevent it from being used over longer distances and on public roads. Even though the T-Pod and other autonomous vehicles cannot yet replace manned vehicles, this example shows that different forms of mobility can function very well in parallel.

Strategic consequences

Manufacturers and OEMs

Development of autonomous (freight) vehicles.

(Further) development of combustion engines and alternative drive systems.

New business models are becoming increasingly important (also to compensate for declining sales): vehicle manufacturers are becoming mobility providers.

Strategic partnerships with technology providers are becoming more important.

Public transport providers

The development of mobility platforms and / or strategic partnerships with mobility providers are becoming more important in order to enable the networking of public transport with individual transport.

Public providers can play an important role for the entry into active traffic management.

Logistics providers

Development of autonomous distribution systems.

Use of autonomous freight transport systems and vehicles.

Drones play a subordinate role.

High efficiency gains in logistics processes.

Larger focus on supply goods and industrial goods, less on experience shopping goods.

Integration of end products in automated logistics processes.

Industry and trade

Advantage of stationary trade for experience shopping can be exploited.

Supermarkets are experiencing high competition from online trading: building up online sales channels is becoming important.

Technology providers

Strong growth in solutions for autonomous driving and cloud-based services.

Strong competition for mobility data: Are these in the hands of manufacturers/providers or other groups?

Mobility services provider

Market growth creates scope for new players with new services.

Mobility service providers will (have to) have strong access to individual transport solutions.

Cities and city planners

Weak position of cities leads to limited opportunities for action: therefore focus on mobility solutions through cooperation.

Higher-level control via environmental guidelines.

Surrounding rural regions

In addition to general location quality, environmental quality is also high in conurbations. Therefore, the surrounding areas lose an important locational advantage.

Citizens and consumers

Use of the most comfortable transport mode, adapted to individual needs.

No customer solution (yet) in the form of a 1-stop-shop for mobility services.

Economic and techno-logical environment	Broad economic participation but data is gathered by only few	Broad economic and technological participation	Economic split of the society and focus of the data in a few hands	Restrained economic development – but broad availability of data	
Technology acceptance and understanding	Inspite of low technology acceptance, plays AI a major role in mobility sector	New technologies incl. AI are broadly accepted and used in mobility sector	Due to low technology acceptance, AI is not used in mobility sector	High technology acceptance, but no use of AI in mobility sector	
Environmental policy	Low environmental quality inspite of high influence of environmental policies	Strong influence of environmental policies leads to high environmental quality	Despite low environmental quality in cities, environmental policies do not have a great significance	High environmental quality in cities inspite of low influence of environmental policies	
Lifestyle / Leisure behavior	Virtual social interactions shape the urban lifestyle	Urban lifestyle is shaped by both physical and virtual interactions	Overall reduced personal interactions (New Cocooning)	Real social interactions shape the urban lifestyle	
Consumption and shopping behavior	Shopping behavior stays the same, groceries will be delivered	Both leisure and grocery shopping lead to high personal mobility	Low personal mobility: shopping takes entirely place virtually	Virtual leisure shopping, real shopping for groceries	Radical changes in consumption behavior: decreasing mobility
Individual mobility needs	Decreasing need for mobilty – demand for high-level services	Strong demand for high-level mobility services	Decreasing need for mobilty – demand for simple services	Strong demand for simple mobility services	Mobility as scarce luxury service
Use of mobility phases	Usage of mobility phases leads to significant changes in mobility behavior	Usage of mobility phases has significant influence on chosen means of transport	Mobility phases are not used differently	Moblity phases are used differently, but do not influence mobility decisions	
General transportation policies	Strong regulation adapted on consequences for mobility: relinquishment	Adaptation on efficiency: stimulation of technology with sustainable goals	Weak general transportation policies: passive politics	Technological support for innovations: focus on growth and creation of workforce	
Drive systems	Electro mobility dominates urban drive systems	Diverse low-emission drive systems, including hydrogen and hybrids	Combustion engines are still dominating urban drive systems	Maximum diversity of drive systems in urban areas	
Autonomous vehicles	Classic and new autonomous vehicles coexist	Autonomous driving leads to new car models and mobility concepts	Evolutionary addition of mobility concepts by autonomous vehicles	Autonomous driving becomes dominant concept in traditional surrounding	Autonomous driving only takes place in niches
Urban development / Urbanization	Massive decentralization: Work and life take place outside of cities	Decentral work environments lead to traffic jams	Decentralized living leads to mobility peaks into cities for work	Centralized cities: short mobility distances, tendency towards micro-mobility	Virtualization of life and decreasing compulsory mobility
Role, power, and identity of cities	Cities use their powerful position for their own agenda	Strong and active role of cities in both politics and economy	Overall weak position of cities in both politics and economy	Cities follow set political agenda, but are economically independent	
Car usage	Private and alternative usage takes place parallely – in both urban and rural areas	Broad substitution of private cars in urban areas	Individual mobility in urban areas is largely characterized by private cars	Strutural changes: private cars are replaced in urban, but not in rural areas	
Urban road infrastructure	Variable and increasingly smart infrastructure	Intelligent infrastructure including reallocation for variable usage	Maintenance of traditional infrastructure	Significant reduction of infrastructure, for micro and collective mobilty	Worsening of infrastructure due to missing investments
Freight transport and distibution systems	Strong regulation of an only partly automated freight and distribution system	Strong regulation of a highly automated freight and distribution system	Mostly constant freight and distribution system	Strongly automated freight and distribution system without significant regulation	
Traffic management systems	Active traffic management in limited systems	Active traffic management in broad systems	Passive traffic management in limited systems	Passive traffic management in broad systems	
Vehicle manufacturers	New manufacturers drive traditional manufacturers out	New manufacturers revolutionize mobility market with new business models	Traditional manufacturers dominate mobility market	Traditional manufacturers dominate mobility market with business models	
Vehicle concepts in urban areas	Conurbation tolerance as primary driver for new vehicle concepts	Conurbation tolerance AND interior usage as driver for new vehicle concepts	Dominance of traditional vehicle concepts	Enhanced interior usage and design as primary driver for new vehicle concepts	
Freight vehicles in urban areas	Traditional driver-focused vehicles are designed more conurbation-friendly	Conurbation-friendly design of new, driverless freight vehicles	Mostly traditional freight vehicles	Optimization of freight transport by automatic and driverless vehicles	
Collective transportation	New CT focused on individual needs in existing infrastructure	New CT focused on individual needs in new infrastructure	Evolutionary further development of existing infrastructure	New infrastructure for individual CT based on traditional vehicle sizes	Continuing dominance of classic collective systems
Micro-mobility	Micro-mobility equiped with engines	Broad usage of micro-mobility – with and without engine	Low relevance of micro-mobility	Micro-mobility mostly without engine	
Air traffic in urban areas	Air traffic only for freight transport	Air traffic for both passenger and freight transport	Air traffic does not play a significant role	Air traffic only for passenger transport	Broad implmentation of air traffic
Integrated mobility services	Passengers only use broad services in special cases	Passengers subscribe long-time to overall services	Passengers only use singular services in special cases	Passengers subscribe to one or only few special services	Mobility services only play a minor role
Modal split for passenger transportation	Broad network of different modes	Classic collective transportation dominates	Classic individual transportation dominates	New mobility concepts arise	Significant reduction of mobility needs
Modal split for freight traffic	Supraregional classic traffic – new concepts only in city centers	Overall high imoprtance of freight transport in urban areas	New freight systems – classic transport loses importance	Freight transport in city centers – other concepts only supraregional	Significant decrease of freight transport

Characteristic projection *Partly characteristic projection* *Unique projection* *Alternative projection*

Scenario 4:

The autonomous mobility scenario

Autonomous cities – autonomous transportation. Urban centers take their mobility situation into their own hands. They strictly enforce environmental regulations and instead offer well-connected and collective modes of transportation. By upgrading and redesigning existing roads, traffic flows can be effectively organized. The use of air transport for the procurement of goods also contributes to relieving the traffic on the roads. The high level of technological confidence also goes hand in hand with an increased demand for quality services.

A new world of mobility

Both society and politics are open-minded and optimistic about new technological initiatives in the sense of improved mobility. However, transport policies actively intervene. For example, private vehicles are being restricted and the automotive industry is being confronted with increased environmental requirements. The industry‘s innovation efforts are also geared to this maxim of environmental compatibility. Technology is primarily used to generate efficiency. This is illustrated by the decline in combustion engines. At the same time, automated solutions embedded in the city‘s smart infrastructure network are being used to cope with the volume of traffic. Taking these political guidelines into account, however, the framework conditions for mobility service providers remain positive - the classic business is supplemented by innovative business models. These different services are well received by the urban population and used by long-term subscriptions.

Cities as autonomy islands

Cities have a wide range of decision-making leeway and develop their own identities - rural areas are falling further back. In metropolitan areas, therefore, much is done inde-

pendently for an efficient flow of traffic. The pronounced co-determination of the cities makes it possible to achieve the desired effect by optimizing the high volume of traffic. Roads are not only adapted to new, smart concepts, but also completely rededicated. Urban Robo Cars and Autonomous Pods determine the image of urban agglomerations. But micro mobility is also becoming more attractive. At the same time, the use of traditional private vehicles is being massively restricted in order to restore environmental quality. This change will be compensated by alternative, efficiently linked forms of mobility. However, it is not only in terms of the decisions taken that cities are more isolated from the rest of the surrounding countryside. This increasing division also applies to transport, as new concepts such as autonomous driving and new infrastructures concentrate on urban areas, thus creating new borders and intersections.

Service-oriented collective transport

By shifting freight traffic to the air or rail, space is created on the roads for motorized micro-traffic and new mobility concepts. On the one hand, these are much more attractive due to the increased environmental quality. On the other hand, they replace the greatly reduced access to traditional, privately used cars. The orchestrated networking of all modes of transportation leads to a functioning urban traffic. Particular attention is paid here to linking the various types of mobility so that it is attractive to have subscriptions for several such services at the same time.

Increased quality standards of the urban population

People trust the central control of their infrastructures. The end-to-end automation of passenger and freight transport enables a completely new mobility behavior for demanding users, especially the alternative use of mobility times. However, this is also absolutely necessary, since the regression of classic forms of mobility, such as motorized private transport, limits the old and much-loved habits of the urban population. For example, individual vehicle ownership is declining massively, while long-term, intermodal services are gaining importance. Here, mobility users expect a high level of comfort and excellent cycle times. A strong networking of the individual services is therefore absolutely essential. After all, it is not only the way to work that has to be mastered, but mobility is also still necessary for meetings with friends or fun shopping trips in leisure time. This new world of mobility at the borders between the city and the surrounding countryside, which cannot keep pace with the massive reorientation of the metropolitan areas, leads to tensions.

Drone captain without season ticket

Julia Herbst tries to focus on several screens at the same time with her lips puckered. It is only 8:30 a.m. on a gloomy Thursday, but the atmosphere at the Hamburg-Süd transport airport is tense due to the wafts of mist.

Julia monitors the flights of several autonomous cargo planes that are delivering cables weighing tons to build the latest smart street-network from Altona to St. Pauli. Due to the stormy weather of the last few days, some drones were unable to take off. Now, despite the foggy weather outside, twice as many are in the air, and the city is really putting on the pressure.

Actually Julia wanted to become a pilot, but she is also satisfied with her job as a drone captain. Most of the work is done by the technology anyway, only in exceptional situations like this, when the trucks in the distribution centre are almost piling up and more drones have to leave despite the bad weather, things get dicey. On good days, Julia enjoys the spectacular images provided by the cameras of the aircraft trucks from the sky above Hamburg. She never actually comes to the city herself, after all she lives outside, and to get to her work in the logistics centre far away she needs a car. However, this does not allow her to enter the city and a season ticket from the HMS (Hamburger Mobility Services) is not really worthwhile.

Her husband Sebastian has such a card because he is a nurse at the Schön Klinik and first rides an e-bike, then the underground and then an Autonomous Pod to the clinic. »It's funny«, Julia thinks to herself, as the first drone prepares to land at the Alton construction site, »that despite these changes and the long distance, he is much faster at work than I am. It's really great how everything goes together with the changing and driving. It's just a pity that I don't have any of that here in the back country.«

Where we can observe the autonomous mobility scenario already today:

Singapore: Autonomous taxis against the lack of available space

The Asian city state of Singapore has a lot to offer – but space is not one of those things. Only due to restrictive traffic policies, a traffic chaos can be prevented. There is simply no room for the expansion and construction of roads. Vehicle licenses are traded at horrendous prices and there are heavy tolls for the use of the advanced infrastructure. At the same time, due to the tropical climate with high humidity and frequent downpours, alternatives such as bicycles can only be used to a limited extent. Instead, taxi rides are comparatively cheap and popular. In order to establish the service as a solution to infrastructure requirements, Singapore focuses its efforts on autonomous vehicles. Research and development, for example, is being actively promoted by the city state through the Future Urban Mobility initiative of the Singapore MIT Alliance for Research and Development (SMART), a partnership with the Massachusetts Institute of Technology. In the One-North area, test cars from several providers are on the road at the same time, since tests are carried out directly under real conditions. Concepts are being tested not only for classic individual transport, but also for collective and freight transport. Services are oriented towards individual needs, on-demand solutions are preferred. Freight traffic is also shifted to nighttime in order to optimize road utilization. Research is also being conducted concerning air mobility. Singapore is thus making a name for itself as one of the pioneers of autonomous driving. This is made possible above all by the stringent political involvement of its ministry. Uncomplicated and always interested in innovation, comprehensive resources are provided and planning drafts are implemented extremely quickly.

Strategic consequences

Manufacturers and OEMs

Focus on the development of autonomous (commercial) vehicles.

Dominance of alternative drive systems. Combustion engines only play a subordinate role.

New business models are becoming increasingly important; vehicle manufacturers are turning into mobility providers.

New suppliers from the technology environment are entering the market.

Public transport providers

Significant promotion of local public transport.

The development of mobility platforms and/or strategic partnerships with mobility providers are becoming more important in order to enable the networking of collective transport with individual transport.

Public providers can play an important role in the entry into active traffic management.

Logistics providers

Far-reaching changes in freight transport, especially in city centres, where new concepts are gaining ground.

MIV-based logistics concepts continue to dominate in supraregional areas.

High efficiency gains in logistics processes and basis for fundamental innovations.

Use of autonomous freight transport systems and vehicles.

Freight air transport is gaining ground in initial fields of application.

Industry and trade

Advantage of stationary trade for experience shopping can be exploited.

Online channels dominate supply shopping - thus high importance of retail logistics.

Technology providers

Strong growth in solutions for autonomous driving and cloud-based services.

High competition for mobility data: Are these in the hands of manufacturers/suppliers or other groups?

Mobility services provider

Market growth creates scope for new players and new services.

Air taxis can develop into a relevant business.

Cities and city planners

Active role of cities and metropolitan areas in the orchestration of transport.

Transformation of roads is gaining importance and creates new possibilities for the design of public spaces.

Surrounding rural regions

Rural areas are less and less able to keep up with urban development and have to find their own positions.

New interfaces between conurbations and the regional environment.

Citizens and consumers

Users benefit from a high speed of innovation and technology promotion with sustainable goals.

Environmental quality in conurbations improves.

Economic and techno-logical environment	Broad economic participation but data is gathered by only few	Broad economic and technological participation	Economic split of the society and focus of the data in a few hands	Restrained economic development – but broad availability of data	
Technology acceptance and understanding	Inspite of low technology acceptance, plays AI a major role in mobility sector	New technologies incl. AI are broadly accepted and used in mobility sector	Due to low technology acceptance, AI is not used in mobility sector	High technology acceptance, but no use of AI in mobility sector	
Environmental policy	Low environmental quality inspite of high influence of environmental policies	Strong influence of environmental policies leads to high environmental quality	Despite low environmental quality in cities, environmental policies do not have a great significance	High environmental quality in cities inspite of low influence of environmental policies	
Lifestyle / Leisure behavior	Virtual social interactions shape the urban lifestyle	Urban lifestyle is shaped by both physical and virtual interactions	Overall reduced personal interactions (New Cocooning)	Real social interactions shape the urban lifestyle	
Consumption and shopping behavior	Shopping behavior stays the same, groceries will be delivered	Both leisure and grocery shopping lead to high personal mobility	Low personal mobility: shopping takes entirely place virtually	Virtual leisure shopping, real shopping for groceries	Radical changes in consumption behavior: decreasing mobility
Individual mobility needs	Decreasing need for mobilty – demand for high-level services	Strong demand for high-level mobility services	Decreasing need for mobilty – demand for simple services	Strong demand for simple mobility services	Mobility as scarce luxury service
Use of mobility phases	Usage of mobility phases leads to significant changes in mobility behavior	Usage of mobility phases has significant influence on chosen means of transport	Mobility phases are not used differently	Moblity phases are used differently, but do not influence mobility decisions	
General transportation policies	Strong regulation adapted on consequences for mobility: relinquishment	Adaptation on efficiency: stimulation of technology with sustainable goals	Weak general transportation policies: passive politics	Technological support for innovations: focus on growth and creation of workforce	
Drive systems	Electro mobility dominates urban drive systems	Diverse low-emission drive systems, including hydrogen and hybrids	Combustion engines are still dominating urban drive systems	Maximum diversity of drive systems in urban areas	
Autonomous vehicles	Classic and new autonomous vehicles coexist	Autonomous driving leads to new car models and mobility concepts	Evolutionary addition of mobility concepts by autonomous vehicles	Autonomous driving becomes dominant concept in traditional surrounding	Autonomous driving only takes place in niches
Urban development / Urbanization	Massive decentralization: Work and life take place outside of cities	Decentral work environments lead to traffic jams	Decentralized living leads to mobility peaks into cities for work	Centralized cities: short mobility distances, tendency towards micro-mobility	Virtualization of life and decreasing compulsory mobility
Role, power, and identity of cities	Cities use their powerful position for their own agenda	Strong and active role of cities in both politics and economy	Overall weak position of cities in both politics and economy	Cities follow set political agenda, but are economically independent	
Car usage	Private and alternative usage takes place parallely – in both urban and rural areas	Broad substitution of private cars in urban areas	Individual mobility in urban areas is largely characterized by private cars	Strutural changes: private cars are replaced in urban, but not in rural areas	
Urban road infrastructure	Variable and increasingly smart infrastructure	Intelligent infrastructure including reallocation for variable usage	Maintenance of traditional infrastructure	Significant reduction of infrastructure, for micro and collective mobilty	Worsening of infrastructure due to missing investments
Freight transport and distibution systems	Strong regulation of an only partly automated freight and distribution system	Strong regulation of a highly automated freight and distribution system	Mostly constant freight and distribution system	Strongly automated freight and distribution system without significant regulation	
Traffic management systems	Active traffic management in limited systems	Active traffic management in broad systems	Passive traffic management in limited systems	Passive traffic management in broad systems	
Vehicle manufacturers	New manufacturers drive traditional manufacturers out	New manufacturers revolutionize mobility market with new business models	Traditional manufacturers dominate mobility market	Traditional manufacturers dominate mobility market with business models	
Vehicle concepts in urban areas	Conurbation tolerance as primary driver for new vehicle concepts	Conurbation tolerance AND interior usage as driver for new vehicle concepts	Dominance of traditional vehicle concepts	Enhanced interior usage and design as primary driver for new vehicle concepts	
Freight vehicles in urban areas	Traditional driver-focused vehicles are designed more conurbation-friendly	Conurbation-friendly design of new, driverless freight vehicles	Mostly traditional freight vehicles	Optimization of freight transport by automatic and driverless vehicles	
Collective transportation	New CT focused on individual needs in existing infrastructure	New CT focused on individual needs in new infrastructure	Evolutionary further development of existing infrastructure	New infrastructure for individual CT based on traditional vehicle sizes	Continuing dominance of classic collective systems
Micro-mobility	Micro-mobility equiped with engines	Broad usage of micro-mobility – with and without engine	Low relevance of micro-mobility	Micro-mobility mostly without engine	
Air traffic in urban areas	Air traffic only for freight transport	Air traffic for both passenger and freight transport	Air traffic does not play a significant role	Air traffic only for passenger transport	Broad implmentation of air traffic
Integrated mobility services	Passengers only use broad services in special cases	Passengers subscribe long-time to overall services	Passengers only use singular services in special cases	Passengers subscribe to one or only few special services	Mobility services only play a minor role
Modal split for passenger transportation	Broad network of different modes	Classic collective transportation dominates	Classic individual transportation dominates	New mobility concepts arise	Significant reduction of mobility needs
Modal split for freight traffic	Supraregional classic traffic – new concepts only in city centers	Overall high imoprtance of freight transport in urban areas	New freight systems – classic transport loses importance	Freight transport in city centers – other concepts only supraregional	Significant decrease of freight transport

Characteristic projection *Partly characteristic projection* *Unique projection* *Alternative projection*

Scenario 5:

The disruption scenario

Nothing remains as it was. A wind of change is blowing through Germany‘s metropolitan areas – even if for some established mobility providers it is likely to grow into a hurricane. A major mobility turnaround is taking place: from automated freight and collective transport to personal aircraft, everything changes and in addition, no infrastructure remains the same. The urban population enjoys their trendy, environmentally friendly lifestyle with full confidence in technology and data (security).

A spirit of optimism in mobility

Economic and technical developments follow the principle of broad participation: Traditional labour models are no longer standard and symbolizing one’s way of living, while politics guarantee all citizens access to the networked world of data and knowledge. Old thinking boundaries have fallen down, which also opens the way to new, disruptive approaches in mobility. This makes it easier for new competitors, for example from the technology sector, to gain a foothold – with the boundary of high environmental compatibility. Classic mobility providers are confronted both with the decline in sales of classic individual vehicles and with an overwhelming number of new, high-tech mobility offers. Even aircraft is becoming affordable due to strong competition and is highly integrated into urban infrastructure. As a mobility service provider, there is a need to keep up with the times. Anyone who succeeds in doing so will encounter an open-minded, mobility enthusiast consumer from both private individuals and cities.

Cities determine way of life

Urban living spaces are developing into centers of power with their own identities - and often into the places where the latest innovations emerge and are being tested. The role of superregional politics is mainly to ensure that the surrounding countryside and rural areas are connected to this development. This is exemplified by transport policy. Existing infrastructures in cities – roads or railways – are not only adapted to the needs of automated mobility units, but also partly adapted to the needs of the urban population. This also enables the establishment of air traffic landing zones within the city. At the same time, the implementa-

tion of alternative types of engines actively ensures high environmental quality. In this way, the individual types of mobility are combined, paying particular attention to social needs.

The sky is no longer the limit

A complete mobility turnaround is achieved in urban traffic – traffic jams and poor air quality are finally a thing of the past. Instead, intermodal mobility services on the basis of completely new, flexible and autonomous means of transport are a completely understandable part of urban life. No one really needs a classic car of their own any more – if it has to be their own aircraft. But micro- and colliding traffic solutions based on a new, intelligent infrastructure, including road rededications, can also be used to get from A to B in the city in an environmentally friendly and convenient way. After all, comfort and the best possible use of mobility times are also very much needed. But the surrounding countryside is not completely forgotten either. Here, political intervention ensures a connection to inner-city infrastructures.

A new way of life

The urban population enjoys its freedom of mobility. Not only will travel times become more convenient and efficient, as they will be shorter, but the environment is also taken into account, so that the quality of life in urban areas will increase significantly. Social interactions continue to play a role, as do shopping trips – people want to have fun and enjoy life. But annoying grocery shopping is a thing of the past since they are delivered directly home by drones. This ideal world of mobility is only possible because the population trusts new technologies, but also knows that their personal data is in safe hands. This is the responsibility of the cities, but also of the economy. The continuous automation of passenger and freight transport thus lead to completely new patterns of mobility. Individual vehicle ownership is declining massively, while long-term, intermodal services are gaining ground. An exception to this, however, is personal aircraft, which is considered to be the latest trend.

The return of Tempelhofer Feld

Last sunday, the opening of the mobility park »Tempelhofer Feld« was celebrated with a big inauguration ceremony. After a construction period of several weeks, Berlin's popular former airport area now has one of the most advanced infrastructures in the world with its fully automated, intelligent drone parking zones.

Berlin's mayor says, »Not only are we extremely proud of this innovative solution, but we are also delighted by this eventual return to the history of flying at Tempelhof, which is also reflected in the consistently positive feedback from the public.«

Tempelhof Airport is unique in its form in Europe and already serves as a model for comparable facilities in Munich, Paris and Dubrovnik. Especially the successful, fully automated orchestration of mobility is inspiring and represents a further milestone in dynamic urban planning. In addition, there is also great interest in the harmonious integration into the cityscape.

Thus, Tempelhof's character as a local recreational area with alternative charm could be preserved, although air traffic now has a direct connection. Both private and collective drones (so-called flight taxis) are guided fully automatically to a corresponding parking lot from a flight altitude of 20 metres. »This is of course a win-win situation, after all, one of our three large underground mobility stations is located under Tempelhofer Feld, from where a wide variety of means of transport can set off in all directions of Berlin.«

And indeed, the population is extremely satisfied with the combination of modern technology, tradition and green recreational area. It hardly matters that a small circle of radical traditionalists is still trying to preserve a classical car park.

»You know, my husband and I come here almost every day and think of the old days.« Ilse Wegener, 78, whose husband used to fly to Tempelhof regularly reports, »With the drone, it's no problem even at our age. Sometimes our dear grandchildren come here in the afternoon, because they change subways here anyway. And they always have time for some ice cream.«

Where we can observe the disruption scenario already today:

Dubai: Smooth traffic in all dimensions

The metropole on the Persian Gulf has not forgotten to dream big since the times of 1001 nights. The Dubai Transport Authority, RAT, is working on the world of tomorrow with several co-operations concerning autonomous driving. Already today, Autonomous Pods, which are used for testing purposes, shape the image of the desert city. These transport units offer space for up to ten passengers, are completely autonomous and can travel at up to 20 km/h. The pods can be used for a wide range of applications. The great innovative spirit in terms of mobility is directed towards a clear goal: with Expo 2020, Dubai wants to present itself as a city of the future. For example, a digital map of Dubai's infrastructure is currently being developed, which will orchestrate all automated traffic. Automation of at least 25 % of all traffic flows is planned by 2030. But it gets even more innovative: since the summer of 2018, tests with air taxis have been running in Dubai. The drones designed for passenger transport land comfortably on the roofs of the city and thus ensure the conquest of the skies for city traffic. The usage of autonomous air drones is also planned for local public transport. The emirate is already building suitable ports for this purpose. The major mobility plans are also evident in another city: Masdar City.

Masdar City was not developed on a drawing board, but simulated on a computer - as a sustainable eco-city in the middle of the desert, just outside the gates of Abu Dhabi. The idea was to plan a climate-neutral city that would meet sustainability goals in all areas. Traffic planning is essential for this project, and the plans were ambitious from the beginning. No cars are allowed on the streets of Masdar City's »Podium Level«; this level is reserved for pedestrians and micro mobility. Underground, there are regional trains on the one hand, and autonomous pods on the other, which are electrically powered and take their passengers from A to their individual destination B without waiting.

Strategic consequences

Manufacturers and OEMs

New technologies and vehicle concepts are to be developed.

Merger of aviation and automotive industry takes place. Dominance of new drive technologies.

Combustion engines play almost no role anymore, also due to the highest efficiency targets.

In the context of new vehicle concepts, interiors are becoming increasingly important.

Disruptive changes create opportunities for new business models and new competitors.

Public transport providers

Alternative mobility offers increase the competitive pressure on public transport providers.

Demand for new usage offerings is increasing.

Options for using mobility times often determine the choice of transport.

The increasing merging of sectors is creating potential for new competitors.

Logistics providers

Far-reaching changes in freight transport, especially in city centres, where new concepts are gaining ground.

MIV-based logistics concepts continue to dominate in the supraregional area.

Strong electrification due to emissions/regulation.

Freight air transport is gaining ground in numerous fields of application.

Need for new vehicle concepts as automation and regulation increases (last mile).

Industry and trade

Shops for the supply of e.g. groceries often disappear from the cityscape, as online shopping is done and delivered directly to the home.

Shopping for fun continues to take place in stationary retail, such as malls.

Technology providers

Strong competition for mobility data: Are these in the hands of manufacturers/suppliers or other groups?

Strong growth in technology-based solutions.

Mobility services provider

Great variety of offers also due to new providers and concepts.

Strongly growing market is also supply-induced.

Fleet offers are in strong demand (car sharing, leasing, ...).

Cities and city planners

Active role of cities and metropolitan areas in the orchestration of transport.

Transformation of roads is gaining in importance.

Cities are becoming more liveable overall.

Surrounding rural regions

Rural areas are increasingly unable to keep pace with urban development.

New interfaces between conurbations and the regional environment.

Citizens and consumers

Users benefit from a high speed of innovation and technology promotion with sustainable goals.

Environmental and quality of life in urbanized areas improves.

Economic and techno-logical environment	Broad economic participation but data is gathered by only few	**Broad economic and technological participation**	Economic split of the society and focus of the data in a few hands	Restrained economic development – but broad availability of data	
Technology acceptance and understanding	Inspite of low technology acceptance, plays AI a major role in mobility sector	**New technologies incl. AI are broadly accepted and used in mobility sector**	Due to low technology acceptance, AI is not used in mobility sector	High technology acceptance, but no use of AI in mobility sector	
Environmental policy	Low environmental quality inspite of high influence of environmental policies	**Strong influence of environmental policies leads to high environmental quality**	Despite low environmental quality in cities, environmental policies do not have a great significance	High environmental quality in cities inspite of low influence of environmental policies	
Lifestyle / Leisure behavior	Virtual social interactions shape the urban lifestyle	**Urban lifestyle is shaped by both physical and virtual interactions**	Overall reduced personal interactions (New Cocooning)	Real social interactions shape the urban lifestyle	
Consumption and shopping behavior	**Shopping behavior stays the same, groceries will be delivered**	Both leisure and grocery shopping lead to high personal mobility	Low personal mobility: shopping takes entirely place virtually	Virtual leisure shopping, real shopping for groceries	Radical changes in consumption behavior: decreasing mobility
Individual mobility needs	Decreasing need for mobilty – demand for high-level services	**Strong demand for high-level mobility services**	Decreasing need for mobilty – demand for simple services	Strong demand for simple mobility services	Mobility as scarce luxury service
Use of mobility phases	**Usage of mobility phases leads to significant changes in mobility behavior**	Usage of mobility phases has significant influence on chosen means of transport	Mobility phases are not used differently	Moblity phases are used differently, but do not influence mobility decisions	
General transportation policies	Strong regulation adapted on consequences for mobility: relinquishment	**Adaptation on efficiency: stimulation of technology with sustainable goals**	Weak general transportation policies: passive politics	Technological support for innovations: focus on growth and creation of workforce	
Drive systems	Electro mobility dominates urban drive systems	Diverse low-emission drive systems, including hydrogen and hybrids	Combustion engines are still dominating urban drive systems	Maximum diversity of drive systems in urban areas	
Autonomous vehicles	Classic and new autonomous vehicles coexist	**Autonomous driving leads to new car models and mobility concepts**	Evolutionary addition of mobility concepts by autonomous vehicles	Autonomous driving becomes dominant concept in traditional surrounding	Autonomous driving only takes place in niches
Urban development / Urbanization	Massive decentralization: Work and life take place outside of cities	Decentral work environments lead to traffic jams	Decentralized living leads to mobility peaks into cities for work	Centralized cities: short mobility distances, tendency towards micro-mobility	Virtualization of life and decreasing compulsory mobility
Role, power, and identity of cities	Cities use their powerful position for their own agenda	**Strong and active role of cities in both politics and economy**	Overall weak position of cities in both politics and economy	Cities follow set political agenda, but are economically independent	
Car usage	Private and alternative usage takes place parallely – in both urban and rural areas	**Broad substitution of private cars in urban areas**	Individual mobility in urban areas is largely characterized by private cars	Strutural changes: private cars are replaced in urban, but not in rural areas	
Urban road infrastructure	Variable and increasingly smart infrastructure	**Intelligent infrastructure including reallocation for variable usage**	Maintenance of traditional infrastructure	Significant reduction of infrastructure, for micro and collective mobilty	Worsening of infrastructure due to missing investments
Freight transport and distibution systems	Strong regulation of an only partly automated freight and distribution system	**Strong regulation of a highly automated freight and distribution system**	Mostly constant freight and distribution system	Strongly automated freight and distribution system without significant regulation	
Traffic management systems	Active traffic management in limited systems	**Active traffic management in broad systems**	Passive traffic management in limited systems	Passive traffic management in broad systems	
Vehicle manufacturers	New manufacturers drive traditional manufacturers out	**New manufacturers revolutionize mobility market with new business models**	Traditional manufacturers dominate mobility market	Traditional manufacturers dominate mobility market with business models	
Vehicle concepts in urban areas	Conurbation tolerance as primary driver for new vehicle concepts	**Conurbation tolerance AND interior usage as driver for new vehicle concepts**	Dominance of traditional vehicle concepts	Enhanced interior usage and design as primary driver for new vehicle concepts	
Freight vehicles in urban areas	Traditional driver-focused vehicles are designed more conurbation-friendly	**Conurbation-friendly design of new, driverless freight vehicles**	Mostly traditional freight vehicles	Optimization of freight transport by automatic and driverless vehicles	
Collective transportation	New CT focused on individual needs in existing infrastructure	New CT focused on individual needs in new infrastructure	Evolutionary further development of existing infrastructure	**New infrastructure for individual CT based on traditional vehicle sizes**	Continuing dominance of classic collective systems
Micro-mobility	**Micro-mobility equiped with engines**	**Broad usage of micro-mobility – with and without engine**	Low relevance of micro-mobility	Micro-mobility mostly without engine	
Air traffic in urban areas	Air traffic only for freight transport	Air traffic for both passenger and freight transport	Air traffic does not play a significant role	Air traffic only for passenger transport	**Broad implmentation of air traffic**
Integrated mobility services	Passengers only use broad services in special cases	**Passengers subscribe long-time to overall services**	Passengers only use singular services in special cases	Passengers subscribe to one or only few special services	Mobility services only play a minor role
Modal split for passenger transportation	Broad network of different modes	Classic collective transportation dominates	Classic individual transportation dominates	**New mobility concepts arise**	Significant reduction of mobility needs
Modal split for freight traffic	**Supraregional classic traffic – new concepts only in city centers**	Overall high imoprtance of freight transport in urban areas	New freight systems – classic transport loses importance	Freight transport in city centers – other concepts only supraregional	Significant decrease of freight transport

Characteristic projection *Partly characteristic projection* *Unique projection* *Alternative projection*

Scenario 6:

The My-Hood scenario

Rediscovery of the closest proximity. The urban population no longer wants to spend valuable time with commuting. Instead, digitization is increasingly being used so that people are working directly from home. It is also much more convenient to go shopping directly in one's own neighborhood by bicycle – the rest is available online. Thus a revival of the residential areas takes place, which develop to districts with an own identity and high degree of individuality identities within the urbanized areas. The infrastructure is significantly relieved and the trend towards micro mobility is further encouraged by the rededication of roads.

Change in frameworks

Cities use their creative freedom to actively intervene in mobility designs. Thus, a completely new mobility market with new requirements is developing. Politics accompany this development with an active environmental policy. The new urban mobility ecosystems are putting the classic automotive and commercial vehicle industry under pressure since diverse new competitors enter the market. For example, the rededication of roads makes micro mobility solutions much more attractive. The changing behavior of the population with regard to mobility must be countered by the automotive industry with appropriate solutions. Entire value chains are being turned upside down by changing demand, but also by increased technological demands. The high pressure to innovate leads to a further promotion of automated systems. Overall, the framework conditions are rather adverse, but offer corresponding niches for regional solutions.

The independency of districts

Although cities continue to have a clear and powerful role, this only becomes clear on a closer look concerning the ongoing regionalization. Digitalization enables a new mixture of functions - and thus overcomes the functional separation of living, working and shopping. Within the cities, small-scale structures in the form of neighborhoods are gaining in

importance, which reduces overall mobility needs and significantly changes mobility patterns. This trend is additionally supported by the cities with the redesign of infrastructure. In coping with these social changes, cooperation with technology providers takes place; there is a supportive mobility system oriented towards the common good. In this way, small and differentiating clusters are created within the city, which are characterized by their own small shops and localities offering everything one needs in daily life.

Short distance mobility

Traditional individual transport services lose importance and are becoming a scarce luxury good due to a variety of costly restrictions. On the other hand, motorized and non-motorized micro vehicles as well as collective transport are gaining in importance. Their infrastructures take precedence over roads that are being significantly converted. This also contributes to an improved environmental situation, which further enhances the attractiveness of micro-transport solutions. For classic collective transport, however, this means a significant change in thinking and planning. Finally, work-related mobility routes are changing and, despite the restriction of individual transport, a decline in the demand for collective mobility services is to be expected. This is due to the fact that the distances to be covered are significantly reduced. Although existing structures will remain in place, changes in the timing and implementation of transport sizes are to be considered. But freight transport is also changing: basic goods are bought in the shop around the corner and many things are also produced on site directly in the neighborhood itself using 3D printing – the rest can be delivered comfortably. The last mile delivery solution, which is coordinated by means of automated freight transport, is thus gaining in importance.

One‘s neighborhood is sufficient

The urban population is open to change. An increased need for a high quality of life and leisure is accompanied by a reflection on regional structures. Mobility behavior is thus undergoing a drastic change. Consumption takes primarily place in one‘s own neighborhood or online; commuter traffic is declining significantly due to the proximity of workplaces to one‘s home. The spatial separation of living and working no longer exists; instead they merge into a large living space. The advantages of urban living with short distances are thus further expanded and realized. The (electric) bicycle and other forms of micro mobility become a daily and, for the most part, perfectly adequate companion. This process is also being driven by increasing digitalization. This way, it is possible to work from home which also helps to bond with the neighborhood, so that social acquaintances are lived out in one‘s own living area. Everything one does not find directly in one’s district can be ordered directly online - thus eliminating other parts of mobility. The production of goods is also often consumer-oriented.

Short distances, high quality of life

»Now hurry up a little, we‘re going to be late!«, tells Lorenz Kater his 8-year-old son Finn. It is always the same. Finn has been going to a new school for a year now, which can be reached by bike in only 5 minutes, and yet the two of them are almost always late.

Finally Finn comes whizzing around the corner, one hand holding onto his bike helmet with the blue bears on it. Father and son leave their apartment in the old building and wave happily to the Grün family, who are already speeding past them on Segways. Lorenz quickly swings himself onto his e-bike, into which Finn‘s smaller child‘s bike is already attached at the back. Off they go to school.

The decision to move was easy for the Kater family. Lorenz and his wife Steffi simply had too little time for Finn and his sister Mia - with all the work and commuting. When the taxes for their little car were doubled, they finally had enough. Now they live in the small quarter of Schönwald, where a school has been newly founded due to the urging of parents. This way, he and Finn can enjoy the short ride through the fresh air every morning, while Steffi walks only a few steps in the other direction to take Mia to the day-care centre.

As an IT specialist for fully automated goods systems, Lorenz was also able to apply for a home office without any problems. To make it less boring, he meets every day with two befriended computer scientists in the café around the corner. Here they work together to develop the most efficient and environmentally friendly last-mile delivery systems. These are in great demand, despite the decline in goods transport.

It never fails to make Lorenz very proud when he realizes that the products in the small shop are fresh every day, also thanks to his work, and that the delivery of the parcels runs so smoothly. Therefore, he treats himself to a piece of cake with fruit that was grown directly on the roof of the little café. After all, he can easily afford it now that he no longer needs a car.

Where we can observe the My-Hood scenario already today:

Barcelona: Car-free districts for a higher quality of life

The fact that planned cities can reinvent themselves is impressively demonstrated by the Catalonian metropolis Barcelona with the rededication of infrastructure in the road blocks called Xamfrans. Since 2013, these blocks of houses planned in the 19th century have been transformed into so-called super blocks as part of the »Urban Mobility Plan of Barcelona« - a super block comprises nine blocks of houses arranged in a square. These blocks, inspired by the city of Vitoria-Gasteiz, create traffic-calmed zones. Cars are allowed at a maximum speed of 10 km/h, and bicycles and pedestrians is always given right of way. In addition, parking facilities have been greatly reduced and are only available in special zones. This means that residents can still use their own car, but more for trips outside of their own district. Additional space that has thus become available, such as former parking lots, can now be used for other purposes. This creates new parks and seating areas for the residents of the neighborhood. Street noise and bad air no longer characterize the everyday life of the neighborhood with playing children and bicycles. The original backyards of the Xamfrans, which were designed as green retreats for local residents, are thus extended to an entire super block – a modern interpretation of traditional life concepts. In addition, the neighborhood's sense of community and identity are strengthened. While the operators of shops bordering the formerly busy streets were initially skeptical that the rededication would have a negative impact on their business, this uncertainty has now given way to a much more positive attitude. After all, pedestrians and cyclists are much more open for a stroll through the local shops than car drivers in a traffic jam and the café tastes much better on a quiet, green street.

Strategic consequences

Manufacturers and OEMs

Significant change in value chains.

Existing / traditional product fields concerning individual transport are no longer applicable.

Many new competitors with new services emerge.

New cooperation possibilities with public and private institutions.

Public transport providers

Regionalisation and localisation can become a competitive advantage for public service providers, but at the same time increases competitive and innovative pressure.

Public providers can basically expand their customer base.

High investment needs in collective transport infrastructure.

Public transport providers competing with new forms of mobility.

Logistics providers

Far-reaching changes in freight transport, especially in city centres, where new concepts are gaining ground.

MIV-based logistics concepts continue to dominate in the supraregional area.

High investment needs in automation to provide local solutions efficiently.

Consolidation of the industry despite regionalisation of freight logistics.

Smaller batch sizes can lead to completely new logistics concepts.

Industry and trade

Decentralized point-of-sales-oriented city concepts characterize the retail landscape.

Adaptation of supply chain processes with regard to automation and an increasing number of stores.

Technology providers

Strong growth in automated systems and related businesses.

High innovation pressure with regional solutions.

High importance of data sovereignty.

Mobility services provider

Risks arise from declining local public transport.

The development of new mobility services is necessary to meet rising customer expectations.

Cities and city planners

Active role of cities and especially districts.

Redesignation of streets and renaturation creates new possibilities for the use of land.

Decentralised maintenance/supply of vehicles.

Surrounding rural regions

Peripheral regions must adapt to the specific development of the urban centres.

Citizens and consumers

Users benefit from improved environmental quality in urban areas.

High physical interaction in the local environment.

Reduced radius of movement and limited individual mobility (mobility is luxury).

Economic and techno-logical environment	Broad economic participation but data is gathered by only few	**Broad economic and technological participation**	Economic split of the society and focus of the data in a few hands	Restrained economic development – but broad availability of data	
Technology acceptance and understanding	Inspite of low technology acceptance, plays AI a major role in mobility sector	**New technologies incl. AI are broadly accepted and used in mobility sector**	Due to low technology acceptance, AI is not used in mobility sector	High technology acceptance, but no use of AI in mobility sector	
Environmental policy	Low environmental quality inspite of high influence of environmental policies	**Strong influence of environmental policies leads to high environmental quality**	Despite low environmental quality in cities, environmental policies do not have a great significance	High environmental quality in cities inspite of low influence of environmental policies	
Lifestyle / Leisure behavior	Virtual social interactions shape the urban lifestyle	**Urban lifestyle is shaped by both physical and virtual interactions**	Overall reduced personal interactions (New Cocooning)	Real social interactions shape the urban lifestyle	
Consumption and shopping behavior	Shopping behavior stays the same, groceries will be delivered	Both leisure and grocery shopping lead to high personal mobility	Low personal mobility: shopping takes entirely place virtually	Virtual leisure shopping, real shopping for groceries	**Radical changes in consumption behavior: decreasing mobility**
Individual mobility needs	Decreasing need for mobilty – demand for high-level services	Strong demand for high-level mobility services	Decreasing need for mobilty – demand for simple services	Strong demand for simple mobility services	**Mobility as scarce luxury service**
Use of mobility phases	**Usage of mobility phases leads to significant changes in mobility behavior**	Usage of mobility phases has significant influence on chosen means of transport	Mobility phases are not used differently	Moblity phases are used differently, but do not influence mobility decisions	
General transportation policies	Strong regulation adapted on consequences for mobility: relinquishment	Adaptation on efficiency: stimulation of technology with sustainable goals	Weak general transportation policies: passive politics	Technological support for innovations: focus on growth and creation of workforce	
Drive systems	Electro mobility dominates urban drive systems	Diverse low-emission drive systems, including hydrogen and hybrids	Combustion engines are still dominating urban drive systems	Maximum diversity of drive systems in urban areas	
Autonomous vehicles	Classic and new autonomous vehicles coexist	**Autonomous driving leads to new car models and mobility concepts**	Evolutionary addition of mobility concepts by autonomous vehicles	Autonomous driving becomes dominant concept in traditional surrounding	Autonomous driving only takes place in niches
Urban development / Urbanization	Massive decentralization: Work and life take place outside of cities	Decentral work environments lead to traffic jams	Decentralized living leads to mobility peaks into cities for work	**Centralized cities: short mobility distances, tendency towards micro-mobility**	Virtualization of life and decreasing compulsory mobility
Role, power, and identity of cities	Cities use their powerful position for their own agenda	**Strong and active role of cities in both politics and economy**	Overall weak position of cities in both politics and economy	Cities follow set political agenda, but are economically independent	
Car usage	Private and alternative usage takes place parallely – in both urban and rural areas	Broad substitution of private cars in urban areas	Individual mobility in urban areas is largely characterized by private cars	Strutural changes: private cars are replaced in urban, but not in rural areas	
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Freight transport and distibution systems	Strong regulation of an only partly automated freight and distribution system	**Strong regulation of a highly automated freight and distribution system**	Mostly constant freight and distribution system	Strongly automated freight and distribution system without significant regulation	
Traffic management systems	Active traffic management in limited systems	**Active traffic management in broad systems**	Passive traffic management in limited systems	Passive traffic management in broad systems	
Vehicle manufacturers	New manufacturers drive traditional manufacturers out	**New manufacturers revolutionize mobility market with new business models**	Traditional manufacturers dominate mobility market	Traditional manufacturers dominate mobility market with business models	
Vehicle concepts in urban areas	Conurbation tolerance as primary driver for new vehicle concepts	**Conurbation tolerance AND interior usage as driver for new vehicle concepts**	Dominance of traditional vehicle concepts	Enhanced interior usage and design as primary driver for new vehicle concepts	
Freight vehicles in urban areas	Traditional driver-focused vehicles are designed more conurbation-friendly	**Conurbation-friendly design of new, driverless freight vehicles**	Mostly traditional freight vehicles	Optimization of freight transport by automatic and driverless vehicles	
Collective transportation	New CT focused on individual needs in existing infrastructure	New CT focused on individual needs in new infrastructure	Evolutionary further development of existing infrastructure	**New infrastructure for individual CT based on traditional vehicle sizes**	Continuing dominance of classic collective systems
Micro-mobility	Micro-mobility equiped with engines	**Broad usage of micro-mobility – with and without engine**	Low relevance of micro-mobility	Micro-mobility mostly without engine	
Air traffic in urban areas	Air traffic only for freight transport	Air traffic for both passenger and freight transport	**Air traffic does not play a significant role**	Air traffic only for passenger transport	Broad implmentation of air traffic
Integrated mobility services	Passengers only use broad services in special cases	Passengers subscribe long-time to overall services	Passengers only use singular services in special cases	Passengers subscribe to one or only few special services	Mobility services only play a minor role
Modal split for passenger transportation	Broad network of different modes	Classic collective transportation dominates	Classic individual transportation dominates	**New mobility concepts arise**	Significant reduction of mobility needs
Modal split for freight traffic	Supraregional classic traffic – new concepts only in city centers	Overall high imoprtance of freight transport in urban areas	New freight systems – classic transport loses importance	Freight transport in city centers – other concepts only supraregional	**Significant decrease of freight transport**

Characteristic projection · *Partly characteristic projection* · *Unique projection* · *Alternative projection*

Scenario 7:

The co-operative scenario

Collective transportation gains in importance compared to individual mobility concepts. The urban population is becoming increasingly tired of cars and their negative impact on the environment and is thus switching to local public transport. This is being intensively promoted by the city, entire streets are being re-dedicated. Motorized transport is thus increasingly being pushed out of the city. This requires a decisive rethink of the customer field in the automotive industry.

Turning mobility around for the common good

Traditional individual mobility has so obviously reached its limits that change is inevitable. Cities are aware of their responsibility and pursue a strict transport policy based on urban compatibility. However, since new technologies do not offer adequate or affordable solutions, politicians are concentrating on promoting new and increasingly individualized collective transport. This will massively restrict motorized private transport, and will also affect freight transport. This politically consistent regulation of urban mobility thus has a massive impact on mobility providers: there is a drastic shift from individual solutions to collective mobility offers. At the same time, alternatives to the classic combustion engine are demanded in order to achieve greater environmental compatibility. The orchestration and information of and about mobility services also requires increased data analysis and technology implementation. Despite this advancing digitalization, traditional mobility providers in particular remain in business, as the basic offer only changes incrementally, only the volume distribution and choice of engines are highly influenced by regulation.

Attractive by regulation

Cities have a strong and active role in politics and business. This dominant position is also accompanied by increased inner-city traffic. Jammed streets, overcrowded parking lots and the associated decline in environmental quality represent a drastic loss in the attractiveness of urban areas. The actions of the cities are correspondingly consistent: motorized private transport is being successfully reduced. While freight transport is only partially affected by this, as the volume is stagnating, passenger transport is particularly active to intervene. This is achieved by large-scale promotion of collective solutions. The range of services is thus expanded, but roads are also rededicated indirectly. In this way, a denser mobility network will be developed for classic local public transport. The resulting coordination tasks will

be mastered with the help of an increasingly smart, actively controllable infrastructure. Micro-transport is also taken into account in the redesign of the urban mobility area and promoted by the rededication of roads. A further focus of the cities is on connecting the surrounding countryside so that commuter flows can be actively managed.

Collective mobility for the masses

The focus of mobility development is on dealing with the accruing volume. After all, cities are still attractive centers with corresponding traffic. For example, traditional vehicle concepts are being redesigned by promoting collective transport and promoting the development of (primarily non-motorized) micro mobility. Mobility services are therefore merely seen as a supplement to these means of transport. The modernization and expansion of existing public transport is treated with the highest priority. Here, the focus is not only on greater environmental compatibility, but in particular on an increased orientation towards the individual needs of the urban population. The growing volume of traffic may not only trigger efforts to increase the frequency, but also to open up new routes. Although the comfort of mobility offers is not ignored, it plays a subordinate role compared to its price policies. Local public transport is expected to replace individual transport with tailor-made solutions, so that orchestration is possible through smart streets. Data on the best possible transport connections is also shared directly with customers via apps. Where collective traffic reaches its limits, it is supplemented by micro traffic.

Mobility for the common good

Due to the continuing high degree of personal social interaction, the demand for mobility of the population in urbanized areas remains high as well. In addition, shopping sprees will continue to take place in person in stationary retail. In addition to its price and environmental compatibility, collective transport also has its own further advantages. The urban population is aware that increased individual transport is not only harmful to the environment but also incompatible with urban infrastructures in the long term. Since the level of demands is low anyway and mobility times can be used differently, public transport is not only an acceptable but rather appreciated solution. After all, with its increasingly individualized services, it offers everything you need to drive from A to B. In this way, it also contributes to the new thinking of less demanding users in urban areas: Individual vehicles (and their industry) suffer from an increasingly bad reputation.

Mobility? Collectivised!

... and yet another new passenger record! For the fourth year in a row, the urban mobility provider »SprintMe« was not only able to transport more people, but also achieved a record profit. This great achievement is also a result of the city's continued subsidization programme.

The company »SprintMe«, partly owned by the city, carried approximately 6 % more passengers in the last business year than in the previous year. At the same time, the annual earnings before interest and taxes increased by 3 %. Michael Kurze, SprintMe's CEO, announced, »As usual, we will use this extra money to invest in innovation. We want to further individualise our offer and win even more citizens for our services. We will also continue to invest in new routes.«

SprintMe will not be the only one pushing for this expansion of routes. In recent years, it has almost become a cherished tradition for the city to dedicate more streets to public transport, thus pushing its unloved stepsister, individual transport, further and further back.

»This development has finally met with an enormous response from the population, because it also protects the environment.« In fact, a survey just finally confirmed the high popularity of SprintMe. This makes it all the easier for the city to continue subsidizing ticket prices. »After all, the money comes mainly from the increased parking fees for all the incorrigible people who still insist on having their own cars.«

The fact that the number of these »unteachable« people is constantly decreasing is exemplified by the closure of the last car dealership on East Street. Not a long time ago, the main road, which somehow always reminded one of American films from the 1960s, was considered the city's car avenue. However, the three last car salesmen were taken over directly by the city, because in the building now available, another bike station is being built to supplement the public transport system.

Where we can observe the co-operative scenario already today:

Tallinn: Attractive collective transport replaces the car

In 2010 alone, the use of means of public transportion in Tallinn fell by over 13 %. While the number of public transport passengers decreased, air and noise pollution increased steadily, so that the Estonian capital decided to take a drastic step: since 2013 the use of the public transport system is free of charge for all inhabitants. Instead of buying tickets, passengers receive a personal smartcard for a deposit. These allow the use of trams and conventional buses. At the same time, the range of services and the route network have been increasingly expanded since 2013 in order to better meet the individual needs of passengers. The metropolis on the Baltic Sea hopes that these measures will not only make public transport more attractive, but also reduce CO2 emissions and thus improve air quality in the city center. The effects of the changed transport policy were empirically investigated in a study conducted by the Royal Institute of Technology in Stockholm. The researchers came to the conclusion that the introduction of free local transport increased passenger numbers by 3%. The elimination of ticket purchases and checks has also reduced the average travel time in public transport. However, particularly positive effects could be achieved through the expansion of the public transport network. The introduction of further stops not only increased the attractiveness of the local public transport network, but also significantly reduced the volume of traffic by expanding bus lanes. Based on these positive experiences, collective local transport in Tallinn will be further expanded. The data collected by the smartcards play a particularly important role. They are used to generate a higher orientation based on the individual movement patterns and thus to expand public transport according to demand.

Strategic consequences

Manufacturers and OEMs

Development of new business fields: Compensation necessary for the loss of sales in the car and truck market due to regulation and low demand.

Alternatives to the combustion engine must be developed in order to continue to be successful.

Compatibility with urban areas as a key objective of new developments for passenger cars and commercial vehicles.

Low risk from new competitors.

Public transport providers

Public providers can generally expand their customer base, but massive growth must be managed.

New collective transport systems geared to individual needs must be developed and the own service portfolio must be restructured accordingly.

Active role in infrastructure development for new collective transport systems.

Public transport providers are in competition with new forms of mobility.

Logistics providers

Far-reaching changes in freight transport through new concepts beyond the MIV.

No increase in logistics demand to private households (last mile), as purchases do not have to be delivered.

Industry and trade

Purchases are generally made in stationary retail.

Connections to new collective transport systems are becoming a locational factor for (even beyond the one to existing road system).

Technology providers

Strong demand for AI solutions for mobility and other areas.

Information technology less necessary for automation, but for mobility services (apps) for end customers.

Mobility services provider

Strong role of public providers and actors in mobility services.

Cities and city planners

Active role of cities, in particular in promoting collective transport and new freight transport concepts.

Redesignation of roads creates opportunities for collective / micro transport or other uses.

Surrounding rural regions

Surrounding regions must pay attention to the connection to new collective systems (e.g. connection to long-distance cycle paths).

Citizens and consumers

Pronounced use of collective and micro transport modes.

Restriction of individual transport is seen less critically if the quality of collective transport is good.

Mobility as a means to an end.

Economic and techno-logical environment	Broad economic participation but data is gathered by only few	**Broad economic and technological participation**	Economic split of the society and focus of the data in a few hands	Restrained economic development – but broad availability of data
Technology acceptance and understanding	Inspite of low technology acceptance, plays AI a major role in mobility sector	**New technologies incl. AI are broadly accepted and used in mobility sector**	Due to low technology acceptance, AI is not used in mobility sector	High technology acceptance, but no use of AI in mobility sector
Environmental policy	Low environmental quality inspite of high influence of environmental policies	**Strong influence of environmental policies leads to high environmental quality**	Despite low environmental quality in cities, environmental policies do not have a great significance	High environmental quality in cities inspite of low influence of environmental policies
Lifestyle / Leisure behavior	Virtual social interactions shape the urban lifestyle	Urban lifestyle is shaped by both physical and virtual interactions	Overall reduced personal interactions (New Cocooning)	**Real social interactions shape the urban lifestyle**
Consumption and shopping behavior	Shopping behavior stays the same, groceries will be delivered	**Both leisure and grocery shopping lead to high personal mobility**	Low personal mobility: shopping takes entirely place virtually	**Virtual leisure shopping, real shopping for groceries**	Radical changes in consumption behavior: decreasing mobility
Individual mobility needs	Decreasing need for mobilty – demand for high-level services	**Strong demand for high-level mobility services**	Decreasing need for mobilty – demand for simple services	**Strong demand for simple mobility services**	Mobility as scarce luxury service
Use of mobility phases	Usage of mobility phases leads to significant changes in mobility behavior	**Usage of mobility phases has significant influence on chosen means of transport**	Mobility phases are not used differently	Moblity phases are used differently, but do not influence mobility decisions
General transportation policies	**Strong regulation adapted on consequences for mobility: relinquishment**	**Adaptation on efficiency: stimulation of technology with sustainable goals**	Weak general transportation policies: passive politics	Technological support for innovations: focus on growth and creation of workforce
Drive systems	**Electro mobility dominates urban drive systems**	**Diverse low-emission drive systems, including hydrogen and hybrids**	Combustion engines are still dominating urban drive systems	Maximum diversity of drive systems in urban areas
Autonomous vehicles	Classic and new autonomous vehicles coexist	Autonomous driving leads to new car models and mobility concepts	**Evolutionary addition of mobility concepts by autonomous vehicles**	Autonomous driving becomes dominant concept in traditional surrounding	**Autonomous driving only takes place in niches**
Urban development / Urbanization	Massive decentralization: Work and life take place outside of cities	**Decentral work environments lead to traffic jams**	**Decentralized living leads to mobility peaks into cities for work**	**Centralized cities: short mobility distances, tendency towards micro-mobility**	Virtualization of life and decreasing compulsory mobility
Role, power, and identity of cities	Cities use their powerful position for their own agenda	**Strong and active role of cities in both politics and economy**	Overall weak position of cities in both politics and economy	Cities follow set political agenda, but are economically independent
Car usage	Private and alternative usage takes place parallely – in both urban and rural areas	**Broad substitution of private cars in urban areas**	Individual mobility in urban areas is largely characterized by private cars	**Strutural changes: private cars are replaced in urban, but not in rural areas**
Urban road infrastructure	Variable and increasingly smart infrastructure	Intelligent infrastructure including reallocation for variable usage	Maintenance of traditional infrastructure	**Significant reduction of infrastructure, for micro and collective mobilty**	Worsening of infrastructure due to missing investments
Freight transport and distibution systems	**Strong regulation of an only partly automated freight and distribution system**	Strong regulation of a highly automated freight and distribution system	Mostly constant freight and distribution system	Strongly automated freight and distribution system without significant regulation
Traffic management systems	Active traffic management in limited systems	**Active traffic management in broad systems**	Passive traffic management in limited systems	Passive traffic management in broad systems
Vehicle manufacturers	New manufacturers drive traditional manufacturers out	New manufacturers revolutionize mobility market with new business models	**Traditional manufacturers dominate mobility market**	Traditional manufacturers dominate mobility market with business models
Vehicle concepts in urban areas	**Conurbation tolerance as primary driver for new vehicle concepts**	Conurbation tolerance AND interior usage as driver for new vehicle concepts	Dominance of traditional vehicle concepts	Enhanced interior usage and design as primary driver for new vehicle concepts
Freight vehicles in urban areas	**Traditional driver-focused vehicles are designed more conurbation-friendly**	Conurbation-friendly design of new, driverless freight vehicles	Mostly traditional freight vehicles	Optimization of freight transport by automatic and driverless vehicles
Collective transportation	New CT focused on individual needs in existing infrastructure	**New CT focused on individual needs in new infrastructure**	Evolutionary further development of existing infrastructure	New infrastructure for individual CT based on traditional vehicle sizes	Continuing dominance of classic collective systems
Micro-mobility	Micro-mobility equiped with engines	Broad usage of micro-mobility – with and without engine	Low relevance of micro-mobility	**Micro-mobility mostly without engine**
Air traffic in urban areas	Air traffic only for freight transport	Air traffic for both passenger and freight transport	**Air traffic does not play a significant role**	Air traffic only for passenger transport	Broad implmentation of air traffic
Integrated mobility services	Passengers only use broad services in special cases	Passengers subscribe long-time to overall services	**Passengers only use singular services in special cases**	Passengers subscribe to one or only few special services	Mobility services only play a minor role
Modal split for passenger transportation	Broad network of different modes	**Classic collective transportation dominates**	Classic individual transportation dominates	New mobility concepts arise	Significant reduction of mobility needs
Modal split for freight traffic	Supraregional classic traffic – new concepts only in city centers	Overall high imoprtance of freight transport in urban areas	**New freight systems – classic transport loses importance**	Freight transport in city centers – other concepts only supraregional	Significant decrease of freight transport

Characteristic projection · *Partly characteristic projection* · *Unique projection* · *Alternative projection*

Scenario 8:

The connected-cocooning scenario

Mobility is being substituted with the help of digitalization. Entire areas of life are being transferred to cyberspace. Accordingly, mobility behavior is declining sharply, tense traffic situations are as a side-effect automatically regulated and the quality of the environment improves. For mobility providers, these fundamentally changed customer needs result in a difficult market situation with falling demand and new requirements.

Shift in mobility paradigms

Digitalization has massively changed people's everyday lives: a substantial amount of processes and interactions is increasingly shifting to digital spaces. The distance to be covered physically, whether due to economic or private activities, is decreasing as well. Moreover, growth is no longer a general paradigm. Instead, the values of sustainability and renunciation are gaining in importance. Politicians are promoting this new development, especially in the context of urban mobility. This has far-reaching consequences for mobility providers. In a world of stagnating economic development, classic automobiles are losing prestige and nonetheless their general perceived utility decreases. The automotive industry is exposed to the effects of this significant decline in traffic. Although no new competitors can settle in this environment, the market as a whole is shrinking. In addition, the demands of mobility users are changing, making the modernization of business models unavoidable. Connectivity, autonomous driving and alternative engine solutions are needed in order to survive in this uncertain environment.

Changed cityscape

With the decline in mobility and the changed economic framework conditions, the image of urban spaces is also changing significantly. The traffic chaos known from earlier days no longer exists in this form, even though the cities themselves continue to be popular and sought-after living spaces. This results in less pressure to act to take mobility concepts into account during urban planning processes. Instead, optimal data and communication infrastructures are gaining in importance. At the same time, new supply systems with increasingly fully automated freight traffic are

emerging. The declining area required for mobility opens up alternative uses, for example for new living or recreational spaces. Environmental quality in cities is improving not only due to declining traffic volumes, but also due to the use of alternative drive systems.

Mobility revolution due to declining demand

Due the new lifestyle of a „virtual life“, the demand for interior design and compatibility is growing within mobility systems. Accordingly, alternative engine types are preferred, for example e-mobility. Great value is attached to the use of mobility times - the digital luxury that is customary at home should not be missing on the move. In connection with this increased networking, however, many journeys become superfluous and the number of passangers is significantly reduced. Due to this declining demand in the unattractive mobility market, the traditional providers continue to dominate. However, they benefit from new, digitally oriented business models. The trend towards transforming existing mobility is also evident in freight transport. The declining consumer behavior, which has been strongly transferred to digital spaces, calls for a higher degree of automation and intelligent route planning in order to efficiently implement cargo transport.

New values in society

The urban population feels very comfortable in their own home - virtual reality replaces physical interactions. Not only work, but also shopping and leisure are increasingly taking place online. The demand for mobility and the volume of traffic have drastically decreased. As a result, mobility is now only needed on a case-by-case basis at specific times and is accordingly called up with the help of individual services. If mobility is needed, the requirements are high. The demands lived at home are also transferred to mobility services. Wifi access on the move is an absolute matter of course. Users use cross-modal mobility services in order to get from A to B as efficiently as possible and without detours. A car of one‘s own would be unnecessary bells and whistles. Such luxury goods are generally rather frowned upon anyway, as they stand for waste and environmental pollution.

You worked as what? Busdriver?

What did urban life look like 20 years ago? Different, that‘s for sure. In our new series »Stories of Yesterday«, the magazine STADTBLATT presents fascinating personalities and their stories from yesterday. Today Hubert Brummer tells us about his experiences as a bus driver.

SB: Dear Mr. Brummer, thank you very much for joining us today from your home. For a long time, you worked as a bus driver. What was that like?

HB: Oh, it was a terribly exciting time. People always wanted to get from A to B, my bus was incredibly crowded and the streets were so crowded as well. You can‘t imagine that anymore.

SB: Do you have a particular favorite memory?

HB: Well, quite a lot. It was always especially nice to sell tickets. With coins, imagine that! And often time’s people asked me whether the bus would also go to a certain destination. In those days there were only a few fixed routes and you had to change buses a lot. And people read timetables to find out how they had to go. Even when there were apps, they were so unreliable. It was crazy!

SB: Do you miss your work?

HB: (sighs) Sure, I had a lot of fun. But all the pollution and the bad mood of the people... it‘s a lot more pleasant to be able to do everything from home. I could have come to you personally for this conversation, but I didn‘t! I‘m also working on a great project for the city. With »HomeBus«, we want to bring the bus driving experience home to the people of today. You only need VR glasses and then you can go on a virtual discovery tour of the city by bus. That‘s a lot of fun! Of course you have to be careful not to miss a bus or get run over, and you can drive the bus yourself and then you have to be careful not to run over anyone yourself...

SB:... Mr. Brummer, thank you very much for this interview!

Where we can observe the connected-cocooning scenario already today:

Seoul: Rededication of an urban motorway reduces car traffic

If a multi-lane urban motorway is simply blocked, one immediately wonders which alternative route the previous users will take. Six kilometers of motorway were demolished in Seoul 10 years ago and the route was transformed back into what it once was: a river. There, nature settled again, and people use the green strip in the middle of the Korean metropolis for picnics, walks and sports. The positive social and ecological effects are immediately obvious - but what happens to traffic if you simply cut off an important infrastructure of the city? Don't the neighboring streets and neighborhoods experience too much traffic? Surprisingly, car traffic simply declined. This effect is also called the »Braess paradox« among traffic planners and can be explained by the fact that an infrastructure optimized for cars is also used intensively (see scenario 1, example Los Angeles). If the infrastructure is not available, car traffic decreases drastically.

This explains why the re-cultivation of an urban motorway does not lead to traffic chaos, but rather to deceleration. The example from Seoul can serve as a model for other cities and is being supported today by the possibilities of digitization. Personal mobility is already no longer necessary to the same extent, because in many professions people can already work from home. The home office is certainly not the solution to all urban mobility bottlenecks, but it can play its part in reducing everyday mobility. And not only can the work take place in the future increasingly »remotely«: In many cases, supply can be provided by e-commerce and decentralized production. Even social activities such as playing on the computer or simply chatting with friends no longer necessarily require a physical encounter. People are more and more »digitally together« and use mobility more consciously and sustainably.

Strategic consequences

Manufacturers and OEMs

Significant change in value chains.

Existing / traditional product fields from the field of individual transport are no longer applicable. Absolute number of private cars is decreasing significantly.

OEMs will have to focus on connectivity, autonomous driving and alternative engine systems in order to maintain their market position despite the decline.

Development into new business areas of mobility services.

Public transport providers

Collective transport services have to fight for the »cocoon consumer« with high-quality individual offers (Wifi, VR, e-commerce...).

Public transport providers are in competition with new forms of mobility.

Logistics providers

Far-reaching changes in freight transport with uncertain market development.

Most likely consolidation of the industry due to the market upheavals.

Industry and trade

3D printing can lead to changes in industrial structures.

Stationary retail is declining; the development of new storage concepts and the usage of delivery services will have to satisfy consumer demand in the future.

Technology providers

Strong growth in the entire digital environment: Everything that contributes to automation and networking - in other words, everything that also contributes to efficient control of the transport system - is widely accepted.

Mobility services provider

On the one hand, there is the risk of declining mobility, on the other hand, there are opportunities due to the decline in private vehicles.

Use of mobility services only with highly individualised offers.

Cities and city planners

Many cities welcome the declining pressure on their transport systems.

The rededication of roads creates new uses for land.

Surrounding rural regions

Virtualisation/digitisation increases the pressure on the surrounding area to provide digital infrastructures.

If digital infrastructures exist, the surrounding rural areas can overcome previous disadvantages.

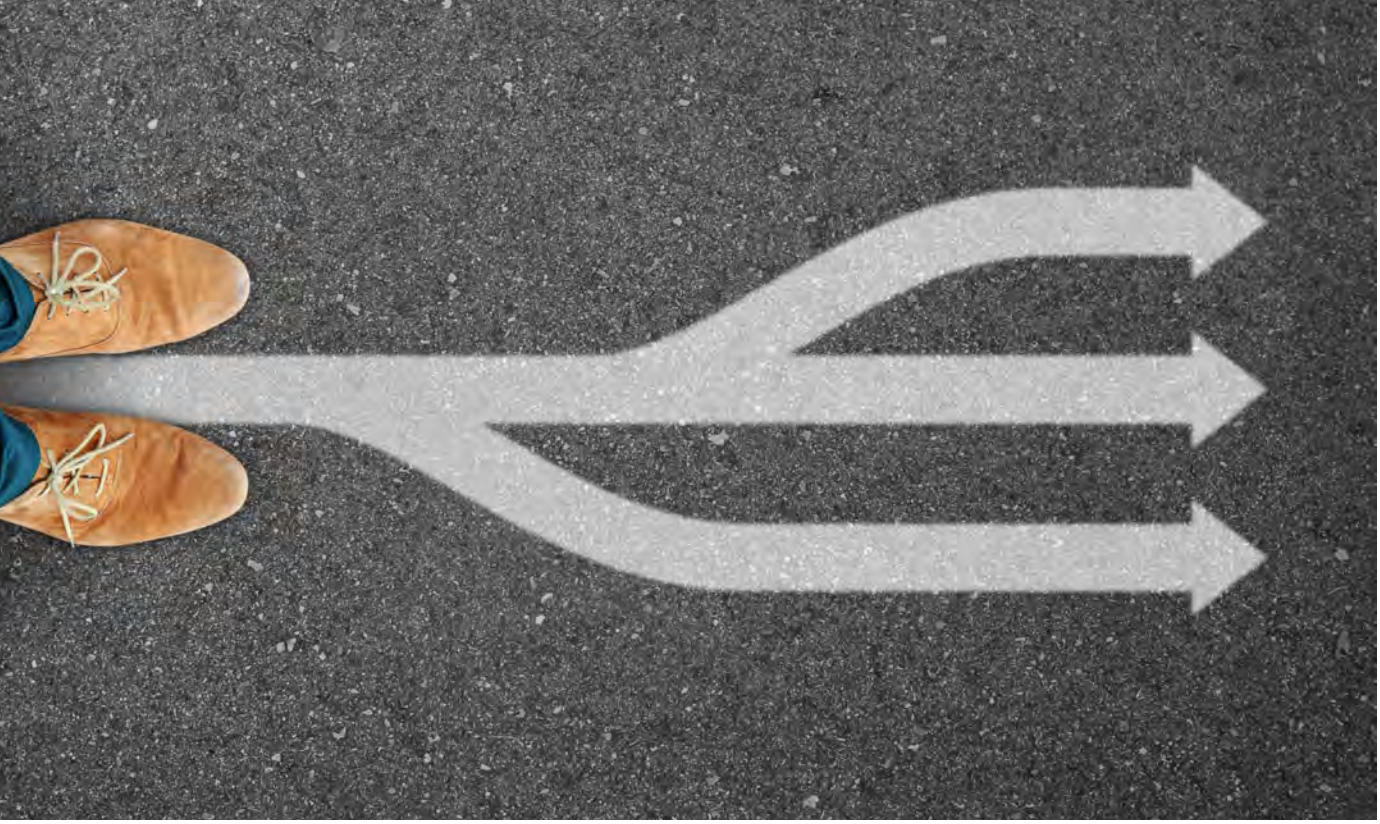
Citizens and consumers

General changes in social interaction have an impact on the mobility behaviour and sometimes the health status of citizens.

The dissolution of the boundaries between work and leisure.

Economic and techno-logical environment	Broad economic participation but data is gathered by only few	Broad economic and technological participation	Economic split of the society and focus of the data in a few hands	**Restrained economic development – but broad availability of data**	
Technology acceptance and understanding	Inspite of low technology acceptance, plays AI a major role in mobility sector	**New technologies incl. AI are broadly accepted and used in mobility sector**	Due to low technology acceptance, AI is not used in mobility sector	High technology acceptance, but no use of AI in mobility sector	
Environmental policy	Low environmental quality inspite of high influence of environmental policies	Strong influence of environmental policies leads to high environmental quality	Despite low environmental quality in cities, environmental policies do not have a great significance	**High environmental quality in cities inspite of low influence of environmental policies**	
Lifestyle / Leisure behavior	**Virtual social interactions shape the urban lifestyle**	Urban lifestyle is shaped by both physical and virtual interactions	**Overall reduced personal interactions (New Cocooning)**	Real social interactions shape the urban lifestyle	
Consumption and shopping behavior	Shopping behavior stays the same, groceries will be delivered	Both leisure and grocery shopping lead to high personal mobility	**Low personal mobility: shopping takes entirely place virtually**	Virtual leisure shopping, real shopping for groceries	Radical changes in consumption behavior: decreasing mobility
Individual mobility needs	**Decreasing need for mobilty – demand for high-level services**	Strong demand for high-level mobility services	Decreasing need for mobilty – demand for simple services	Strong demand for simple mobility services	Mobility as scarce luxury service
Use of mobility phases	Usage of mobility phases leads to significant changes in mobility behavior	**Usage of mobility phases has significant influence on chosen means of transport**	Mobility phases are not used differently	Moblity phases are used differently, but do not influence mobility decisions	
General transportation policies	**Strong regulation adapted on consequences for mobility: relinquishment**	Adaptation on efficiency: stimulation of technology with sustainable goals	Weak general transportation policies: passive politics	Technological support for innovations: focus on growth and creation of workforce	
Drive systems	**Electro mobility dominates urban drive systems**	**Diverse low-emission drive systems, including hydrogen and hybrids**	Combustion engines are still dominating urban drive systems	Maximum diversity of drive systems in urban areas	
Autonomous vehicles	Classic and new autonomous vehicles coexist	Autonomous driving leads to new car models and mobility concepts	Evolutionary addition of mobility concepts by autonomous vehicles	**Autonomous driving becomes dominant concept in traditional surrounding**	Autonomous driving only takes place in niches
Urban development / Urbanization	Massive decentralization: Work and life take place outside of cities	Decentral work environments lead to traffic jams	Decentralized living leads to mobility peaks into cities for work	Centralized cities: short mobility distances, tendency towards micro-mobility	**Virtualization of life and decreasing compulsory mobility**
Role, power, and identity of cities	Cities use their powerful position for their own agenda	Strong and active role of cities in both politics and economy	Overall weak position of cities in both politics and economy	**Cities follow set political agenda, but are economically independent**	
Car usage	Private and alternative usage takes place parallely – in both urban and rural areas	**Broad substitution of private cars in urban areas**	Individual mobility in urban areas is largely characterized by private cars	Strutural changes: private cars are replaced in urban, but not in rural areas	
Urban road infrastructure	Variable and increasingly smart infrastructure	Intelligent infrastructure including reallocation for variable usage	**Maintenance of traditional infrastructure**	Significant reduction of infrastructure, for micro and collective mobilty	Worsening of infrastructure due to missing investments
Freight transport and distibution systems	Strong regulation of an only partly automated freight and distribution system	**Strong regulation of a highly automated freight and distribution system**	Mostly constant freight and distribution system	Strongly automated freight and distribution system without significant regulation	
Traffic management systems	Active traffic management in limited systems	**Active traffic management in broad systems**	Passive traffic management in limited systems	Passive traffic management in broad systems	
Vehicle manufacturers	New manufacturers drive traditional manufacturers out	New manufacturers revolutionize mobility market with new business models	Traditional manufacturers dominate mobility market	**Traditional manufacturers dominate mobility market with business models**	
Vehicle concepts in urban areas	Conurbation tolerance as primary driver for new vehicle concepts	**Conurbation tolerance AND interior usage as driver for new vehicle concepts**	Dominance of traditional vehicle concepts	Enhanced interior usage and design as primary driver for new vehicle concepts	
Freight vehicles in urban areas	Traditional driver-focused vehicles are designed more conurbation-friendly	**Conurbation-friendly design of new, driverless freight vehicles**	Mostly traditional freight vehicles	Optimization of freight transport by automatic and driverless vehicles	
Collective transportation	**New CT focused on individual needs in existing infrastructure**	New CT focused on individual needs in new infrastructure	**Evolutionary further development of existing infrastructure**	New infrastructure for individual CT based on traditional vehicle sizes	Continuing dominance of classic collective systems
Micro-mobility	**Micro-mobility equiped with engines**	**Broad usage of micro-mobility – with and without engine**	Low relevance of micro-mobility	Micro-mobility mostly without engine	
Air traffic in urban areas	Air traffic only for freight transport	Air traffic for both passenger and freight transport	**Air traffic does not play a significant role**	Air traffic only for passenger transport	Broad implmentation of air traffic
Integrated mobility services	**Passengers only use broad services in special cases**	Passengers subscribe long-time to overall services	Passengers only use singular services in special cases	Passengers subscribe to one or only few special services	Mobility services only play a minor role
Modal split for passenger transportation	Broad network of different modes	Classic collective transportation dominates	Classic individual transportation dominates	New mobility concepts arise	**Significant reduction of mobility needs**
Modal split for freight traffic	Supraregional classic traffic – new concepts only in city centers	Overall high imoprtance of freight transport in urban areas	New freight systems – classic transport loses importance	Freight transport in city centers – other concepts only supraregional	**Significant decrease of freight transport**

Characteristic projection — *Partly characteristic projection* — *Unique projection* — *Alternative projection*



Scenario-Assessment:

Paths of development into the future

Our scenarios are initially „thinking tools“ to which no probabilities are assigned. This is the only way we are able to display very different possible futures which inspire us to think outside the box. However, if scenarios are used in the context of concrete strategy and planning processes, further questions arise: How much change – as seen from today – is associated with a scenario? What development do we expect for the future? And are there scenarios that we would rather see happen than others? These questions are investigated within the framework of a scenario assessment.

The scenarios were developed by an interdisciplinary team consisting of mobility experts from various industry players (see page 5). This team subsequently also carried out the evaluation and assessment of the scenarios. The future projections of the individual key factors were evaluated. This analysis then enabled an evaluation for individual key factors as well as a summary of the evaluations and thus an assessment of the higher-level scenarios.

Clear development trend – but numerous paths of development

The chart on page 45 below shows the evaluation results at scenario level. First of all, it becomes clear that the two scenarios of the traditional mobility worlds – i.e. scenario 1 (»petit-bourgeois scenario«) and scenario 2 (»evolution scenario«) – show the greatest agreement with the present, i.e. they contain the least changes. Scenarios 3 (»individual innovations scenario«) and 7 (»co-operative scenario«) also show significant similarities with the current situation.

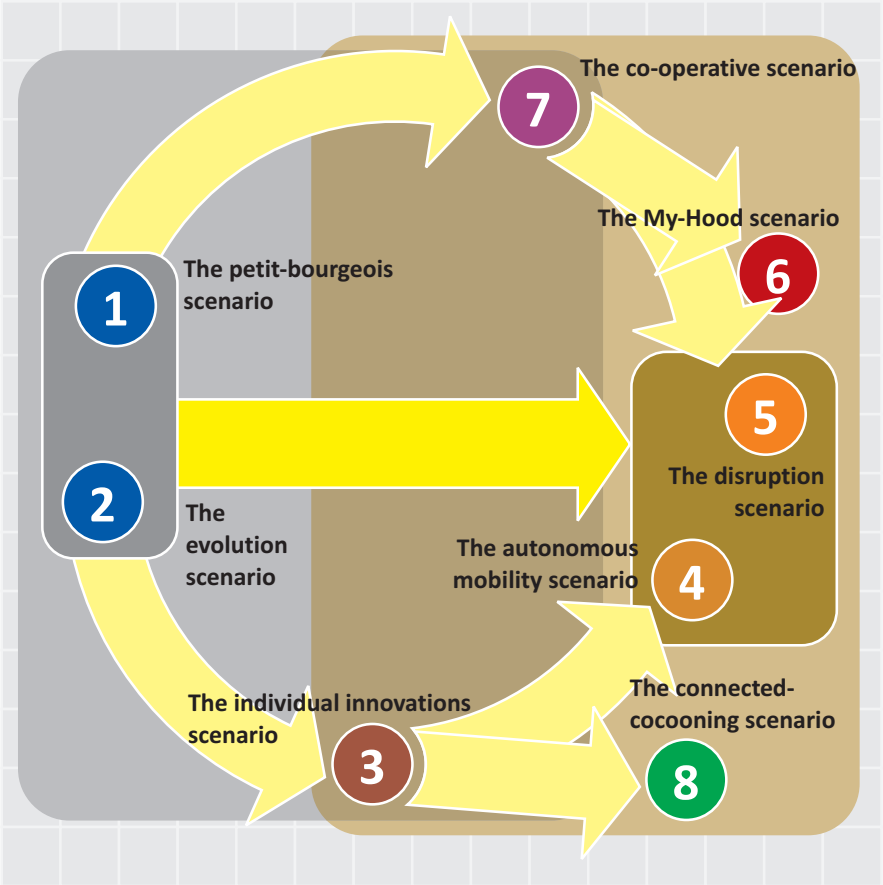
If we now look at the scenarios expected for 2040, a completely different picture emerges. Scenarios 4 (»autonomous mobility scenario«) as well as scenario 5 (»disruption scenario«) are the closest to the expected future. Here, too, there is a wider range of expectations, which then additionally includes scenarios 3 (»individual innovations scenario«), scenario 6 (»My-Hood scenario«), scenario 7 (»co-operative scenario«) and scenario 8 (»connected-cocooning scenario«).

This massive expected change is also visualized in the map of the future (page 45, top). The present space on the left and the expected space on the right are directly opposite each other. Therefore, it is fair to conclude that the expected changes could hardly be any greater.

The exciting question now is how this change could take place over the next twenty years.

First of all, it is both obvious and thus also conceivable that the autonomous mobility scenario as well as the disruption scenario could result directly from the current development. This would require many drivers of change to coincide – and in certain cases, disruptive innovations would have to take place, especially in autonomous driving or completely new concepts such as urban air traffic.

But what if the development does not follow the direct development path shown in the darker yellow illustrated in the picture on the right-hand side? In this case, it is possible that other scenarios will appear as milestones on the way to the new mobility worlds. Such a path leads via technological innovations in the field of individual transport towards »autonomous mobility« (scenario 4) and »disruption« (scenario 5). Starting from today's »evolution scenario«, this development path leads via the »individual innovations scenario« towards autonomous mobility. Individual transport will continue to play a strong role during these changes, but the technologies and thus the way cars and delivery services are used will change fundamentally. What manifests today as driver assistance systems will expand to fully autonomous traffic by 2040. Today's problems of the quite new technologies can be solved and with the growing safety and the advantages in terms of traffic flow and efficiency and the acceptance problems will soon be forgotten. Optimizing road traffic is enough in most cities to get traffic problems permanently under control. If innovations in individual transport are not sufficient, new technologies and dimensions of the »disruption scenario« must be added. As a result of years of research and development, the solution in the urban traffic of the future is a low-emission, perfectly coordinated mix with a continuing high significance of individual transport services.

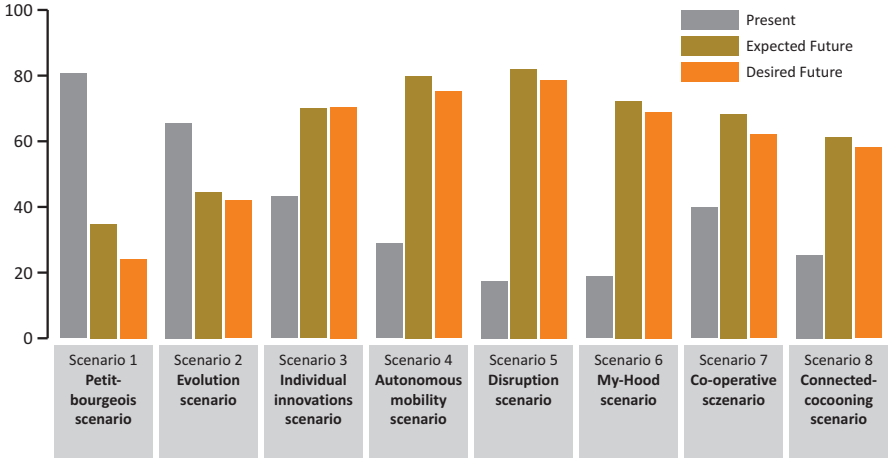


Alternative developments

All eight scenarios are designed to represent fundamentally possible developments in 2040. So it is by no means certain that we will be living in a world closely linked to scenario 4 or 5 in twenty years' time. In particular, the other four scenarios from the extended expectation range could also occur and are worth a closer look in terms of conceivable end points of the development.

Scenario 3 (»individual innovations scenario«) assumes the emergence of individual transport compatible with urban areas – with new vehicle concepts and smart infrastructure and a parallelism of self-controlled and autonomous vehicles. Collective transport is integrated via multimodal approaches, but cannot increase its share in the modal split. On the other hand, freight transport is highly automated and makes a large contribution to the conurbation compatibility of individual transport.

Scenario 6 (»My-Hood scenario«) can also be understood as an alternative endpoint scenario. Here, changes in living habits and urban structures are the central driver: everyday mobility is reduced, since many distances become shorter and can be covered on foot or with micro transport solutions. Within the framework of new concepts of urban development, there are manifold innovations that are less focused on drive technologies and individual transport, but no



less effective and groundbreaking for urban mobility of the future.

Scenario 7 (»co-operative scenario«) provides an even larger contrast to scenario 3. What if mobility in conurbations could only be shaped by growth in (intelligent) collective transport? In this scenario, the premise would apply that the focus on individual transport has proved to be a long-term development mistake.

And finally, scenario 8 (»connected-cocooning«) could also prove to be an endpoint scenario – possibly more than any other. Here, virtualization of further areas of life would lead to a sharp decline in the demand for mobility, but not only in urban areas. This would reduce the investment potential in the mobility sector as a whole; starting from existing infrastructures and systems, innovations that fit into this new world view would prevail.

The future remains open

Which of the development paths described will cities and conurbations in Germany and Europe follow? And will it be the same path in every city? The evaluation of the scenarios does not describe a mathematical probability and does not represent a simulation of the future. Moreover, it is more than conceivable that different cities with completely different framework conditions will also develop differently regarding the future. It is important to know the alternatives and to set the course early on, because it is certain that decisions made today (and this includes not deciding or doing nothing) will have a decisive impact on the quality of life and the scope for action in the future.

Outlook:

Working with scenarios

For successful use of scenarios, it is important that all participants have the same understanding of the function and effect of scenarios. This includes several general assumptions:

- Scenarios are not the »one and only true« future, but a possible course of the future. Individual elements in a scenario are not »the only possibility«, but usually »the one that matches best the other elements in the scenario«.
- Scenarios are not strategies but (thinking) tools for the development of better strategies.
- Scenarios are not objective, but »group-subjective« – which means that they represent the points of view of the scenario team.
- Scenarios contain no decisions, but present environments within which we have to make decisions.
- Scenarios are not »developed well« when they occur precisely, but when they support orientation, decision-making and learning processes in companies in a targeted manner.

Scenarios are used in diverse manners in companies and organisations. Below, six important application options are presented.

Evaluation of the scenarios and derivation of development paths (Use case 1)

For scenarios that are based on extreme future projections, probabilities cannot be sensibly determined. Since many decision-making processes will still require statements on current development trends, an evaluation can be performed after describing the scenarios. In this step of the procedure, the present, expectation and desired future are assessed for the projections of every single key factor. This permits the determination of trends, stabilities and changes, as well as opportunities and risks. At the same time, it can be shown towards which scenarios in the future space the current development points. Based on this, paths from today to the individual scenarios can be sketched. Often specific paths appear through which the change processes take place.

Consequence analysis (Use case 2)

Many of one's own action options are reactions to context developments. Therefore, it is often first about analysing the effects of the scenarios on one's own company, one's own organisation or region. In this effect analysis, all scenarios should be kept »in play" for as long as possible to thus also identify the opportunities hidden in the allegedly more negative scenarios and the often-suppressed dangers of superficially »good« development. For these opportunities

and risks, specific options for actions in the form of measures, projects or programmes can be defined.

Robustness check (Use case 3)

External scenarios are like the »long-term weather report« for a transaction or an activity. Therefore, present strategies or concepts can be reviewed for their future capability with the help of scenarios. In this manner, the weaknesses of present strategies become clear. At the same time, it becomes recognisable whether and how far the strategies are robust against changes to the environment.

Scenario-supported decision-making (Use case 4)

How we handle uncertainty depends on how many and which context scenarios are considered in a strategic decisions. Two extremes can be differentiated: in the scope of focused strategies, we focus on an expected scenario and develop a matching strategy. In the scope of robust strategies, several – or even all – scenarios are considered for actions taken. As a consequence, two types of scenarios can be differentiated between from the strategy's point of view: strategy-forming scenarios are the basis of one's own action. Often, they are specified more closely, to serve as the basis for roadmaps and plans. Strategy-critical scenarios in contrast are not a basis for one's own strategy. However – and this is a central item of Szenario-Management™ – they should not be neglected. Such rather improbable scenarios must be observed. Therefore, they form the focus for systematic early recognition in the scope of scenario monitoring.

Scenario Monitoring (Use case 5)

Scenarios are like »maps of the future« – therefore, they should not be discarded after first use, but continue to be used. This process of regular observation of a future space developed by scenarios is called scenario monitoring. It can be linked with trend management to become an early recognition process.

Scenarios in change processes (Use case 6)

Scenarios have also turned out to be an important instrument in systematic change processes. They make external change possibilities as well as one's own options for action clearer and contribute to the openness of managers and originations towards the future.

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