

# MOBILITY. FULFILMENT. SYSTEM.



ON THE FUTURE OF  
MOBILITY 2025+

FUTURE STUDY  
MÜNCHNER KREIS VOLUME VII



FUTURE STUDY MÜNCHNER KREIS VOLUME VII

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# FOREWORDS



## State Secretary Pschierer, Bavarian Ministry of Economic Affairs and Media, Energy and Technology

Mobility and future challenges posed by digitisation are topics that are currently at the centre of public discussion. This is hardly surprising: digitisation, with its innovative technologies, will have serious impacts on future mobility. Self-driving cars, the possibilities of the sharing economy, and even the establishment of platforms such as Uber or BlaBlaCar are just a few of the manifestations that provide hints about the disruptive power of digitalisation on future mobility.

The value of traditional mobility providers as well as user behaviour will undergo drastic changes in the coming years. Certainly, a country such as Germany, where the automobile industry is broadly positioned, will be profoundly affected by these developments. Thus, it is important that we begin dealing with the future mobility challenges at an early stage and very specifically to set the relevant course in a timely manner. Politicians have already taken action by funding investigative research projects, and with the establishment of Digital Mobility Hubs in Munich as well as the topic platform for Networked Mobility within the Zentrum Digitalisierung.Bayern. Against this backdrop, I'm pleased that the MÜNCHNER KREIS has turned its focus to the topic of mobility in the seventh phase of its Future Studies. While more immediate issues have been in the foreground for some years, the current study is dedicated to

the challenges for mobility in the years 2025+ and to identifying which steps are necessary now and in the near future in order to face these challenges.

The professional and methodological expertise of the MÜNCHNER KREIS and its partners has made it possible to highlight nine critical topic areas that enable an all-encompassing perspective on the topic of digital mobility. The study will interest politicians, for instance due to its discussion of the handling of personal mobility data or the design of access to future mobility infrastructures. It is also a source of information for businesses; the study presents in detail the changes wrought by new mobility marketplaces, and the challenges of establishing customer interfaces and increasing the customer focus.

I would like to give sincere thanks to the MÜNCHNER KREIS, its partners, and all the experts who contributed to this study with their knowledge and for their dedication. The current study, building on previous studies about the future of information and communication technologies, has succeeded in setting new impulses and impetus for the future design of the digital transformation in Germany.

You will be encouraged and inspired by the exciting multitude of perspectives from which the topic of digital mobility can be viewed!

## MÜNCHNER KREIS and Partners

The new "Future Study MÜNCHNER KREIS Volume VII" focuses on the topic of intelligent, networked mobility. Paramount is not those topics often discussed in studies about the effects of digitisation on established value-creation structures, or the question of who will be occupying the future interface to customers. Instead, we are more interested in gaining an all-encompassing overview of mobility and how it will be represented in the future over the course of the digital transformation. While digitisation changes established value creation structures and ushers in an increasing number of platforms, it also changes customers' requirements and needs for mobility in the future. The current Future Study's primary goal is to comprehensively deal with mobility fulfilment 2025+ and to work out the central challenges facing the various stakeholders: politicians, companies, and users.

The interdisciplinary makeup of the partners enabled a focus on mobility and mobility fulfilment while permitting at the same time a networked perspective. Methodologically this resulted in a multistage research process primarily based on workshops with the partners, a qualitative Delphi survey with the inclusion of numerous external experts, and a quantitative validation. The three central findings of this interdisciplinary and multifaceted study phase can be summarised as follows:

1. The development of a "mobility fulfilment system" as a conceptual starting point.
2. The identification of nine subject areas that address the relevant questions associated with the composition of mobility fulfilment 2025+.
3. Challenges for politicians, companies, and users considering the questions of mobility fulfilment 2025+.

With this Future Study, which concludes the seventh phase of the long-term "Future Study" project, the MÜNCHNER KREIS and its partners wish to provide orientation to help make decisions about the digital transformation of mobility, or to consciously not make these decisions, or to make them differently. Considering the immense importance of mobility for the German economy, and examining the implications for other areas – including work, urbanisation, leisure time, living, health, and more – these decisions and actions relating to future mobility have implications that should not be underestimated. The MÜNCHNER KREIS and its partners thank the experts who contributed their knowledge to identifying and working out the central topics and challenges of future mobility. These topics and challenges should provide impulses, impetus and inspiration – for the successful creation of future mobility and the decisions and measures to this end.

# PARTNERS

## THE PARTNERS OF THE **FUTURE STUDY** **MÜNCHNER KREIS** VOLUME VII

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Energy and Technology

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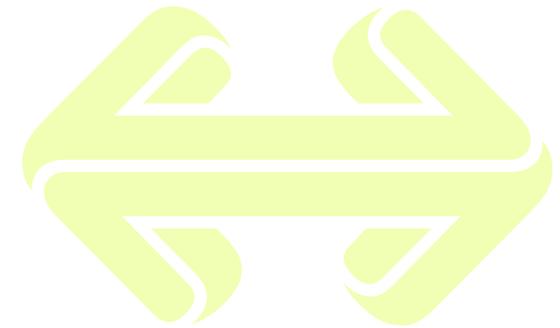
### **CONDUCTED BY**

Kantar TNS

deep innovation GmbH

European Center for Information and  
Communication Technologies (EICT) GmbH

Technical University of Munich,  
Chair for Information Systems



# EXECUTIVE SUMMARY

## 1. Overview

Key players of the German mobility industry and the MÜNCHNER KREIS present this study to provide guidance – amidst a **radical and disruptive process of change** – for a transition to mobility 2025+ over the intermediate term. The study results illustrate the exponential growth of networking requirements in a **360-degree perspective** and the compelling need to picture a connected mobility fulfilment system.

The study's conceptual framework of a future **"mobility fulfilment system"** made it possible to analyse the potential, current, and future products and services, providers, users, designers, the interfaces to goods transport, and the mobility infrastructures undergoing profound **change in relation to one another**.

In doing so, the predominant role of the **digital transformation of industries and society** for the future of mobility came into focus for almost all the issues.



# EXECUTIVE SUMMARY



## 2. Propositions

**The main contribution of the study is the identification and analysis of nine critical topic areas:** 1. Mobility data as currency: Between ownership, transparency and added value; 2. Mobility without a digital divide; 3. Real-time mobility marketplace: Radical change in value creation; 4. Political change in the understanding of infrastructure; 5. Challenges for mobility systems in change; 6. Traditional mobility providers lose direct contact to customers; 7. Added value drives mobility; 8. Potentials for mobility avoidance; 9. Goods transport in radical transformation.

The substance of each finding is framed by a **thesis**, a **central finding**, and a **recommended action**:

### 2.1 Anonymity is an illusion!

Future mobility won't work without the use of personal data!  
Establishment of effective, uniform regulations for Europe is a top priority.

### 2.2 Offliners will be left behind!

Future access to mobility is digital. In order to attract "offliners", we must create and successfully communicate the benefits of digital access; this also requires the development of robust access interfaces!

### 2.3 Hostile takeover – people and goods will be travelling differently in the future!

Global platforms for mobility will produce radical changes in value creation. Maintaining open and free marketplaces is therefore of fundamental importance.

### 2.4 Yesterday's understanding of infrastructure blocks tomorrow's infrastructure policies!

Infrastructure policies lack an integrated approach. There is an urgent need for the creation of expertise in domain-spanning and accelerated infrastructure policy decisions.

### 2.5 No more insular thinking!

Thinking in either/or categories restricts mobility. Flexibly connecting all mobility options creates a potential that must be utilised to the fullest.

### 2.6 Providers are flying blind – Do you know your customers?

Traditional mobility providers are too slow in addressing customer needs such that new mobility ecosystems will be designed without them. Customer focus must be the key target for success..

### 2.7 Mobility is more than just arriving!

Added value increasingly means influencing the selection of the means of transport. New transport features as well as additional offerings for how to spend time while in transit will be a factor and useful for gaining competitive advantages.

### 2.8 Virtual mobility substitutes physical mobility!

Physical mobility can be done without and it will work. Virtual mobility in the working world and living environment must be understood as a real mobility alternative.

### 2.9 Coming to a grinding halt – goods and people compete for transport space!

Logistics drives future mobility innovations. Passenger transport and goods transport in the Smart City must be understood as an integrated network and operated as such.

**Trailblazing decisions** must be made in all nine topic areas – by private companies and by public-sector providers and politicians alike. These decisions will have profound consequences for us as users, requiring us to take up new perspectives and, as the saying goes, requiring us to think outside the box. A comprehensive look at the topic areas results in **four basic findings**:

### 3.1 Future mobility and personal mobility data – opportunity and inhibitor!

Future mobility fulfilment systems will only function with the use of personal data. This can result in promising business models if uniform regulations for the use of personal mobility data can be successfully established. Failing that, limitations for the further development and utilisation of future mobility fulfilment systems will emerge. Consequently, the use of personal data requires a fundamental social and legal consensus at the international level.

# EXECUTIVE SUMMARY

## 4. Challenges



Due to these and many additional individual results, the **stakeholders** of future mobility fulfilment systems face the following **central challenges**:

### 4.1 Politics

Future mobility infrastructures combine infrastructures and modalities that have been planned separately to date. Consequently, planning and design of future infrastructures must take place across all these modalities. This necessitates a system-wide perspective that incorporates the interdependencies between the various elements of a mobility fulfilment system (stakeholders, products/services, digital and non-digital infrastructures, regulatory frameworks) and involves all stakeholders. A purely industry-specific value chain or differentiated planning and actions that separate digital and more traditional infrastructures is no longer expedient against the background of the demand for intelligently networked mobility 2025+.

### 3.2 Necessary interfaces to digital networking don't yet exist!

Future mobility fulfilment systems will be digital, networked, and offer integrated mobility solutions. They will only work when access has been sorted out for "offliners", when users and companies stop their insular thinking about mobility, and future infrastructure planning occurs across multiple domains.

### 3.3 A new customer focus as a factor for success!

Future mobility ecosystems must quickly and comprehensively adapt to changing customer needs – both with respect to transportation from point A to point B as well as with respect to offering additional services for using the time during transport. As a consequence, a variety of mobility services will arise, the complexity of which can quickly overtax users as regards selection, price comparison, and handling. This requires open, free, and easy-to-use marketplaces that provide customers with the necessary information.

### 3.4 Overcoming boundaries – both in thinking and action!

Insular thinking and either/or categories cap potential for synergies and thus are out. Users, providers, and politicians must prepare for integrated mobility solutions. This requires intelligent, seamless connections:

1. Between non-digital infrastructure elements (streets, rails, etc.) with new infrastructure elements (particularly with communication technologies, but possibly also with new physical transportation systems);
2. Between mobility solutions for passenger transportation;
3. Between the transport of people and goods, and;
4. Between concepts for mobility fulfilment and those for mobility avoidance.

## 4.2 Companies

Against the backdrop of these results, private companies and public-sector enterprises will essentially be facing three challenges:

→ Companies cannot lose customer (contact). Firstly, this refers to who will be taking on responsibility for the customer interface in the future. Secondly, it relates to quickly recognising customer needs early on and addressing them while recognising that these needs are changing due to digitisation and other developments.

→ Companies must redefine their roles in future mobility fulfilment systems. Against the backdrop of the increasing emergence of platforms and marketplaces as well as the development of new services, this especially means that business models must be newly aligned to this mobility world and the variety of opportunities for new services must be exploited. Note this also holds true for companies that weren't previously positioned in existing mobility fulfilment systems. There are opportunities at the products/services level, the platform/marketplace level, and at the technical infrastructure level.

→ Companies must factor in cross-modality interdependencies in their planning. This requires cross-industry collaboration.



## 4.3 Users

Users must think outside the box in the future. A variety of innovative possibilities will be available to fulfil mobility needs (transport from point A to point B, plus added value). Users will have to define their needs, think about their mobility behaviour, come to grips with the new services, identify those services that are suitable, and then access and use said services. This could also include the conscious decision to eschew physical mobility.

**Overall, the results of the current MÜNCHNER KREIS Future Study VII show how the topic of mobility must be handled with substantively diverse methods when approached from an interdisciplinary, networked system perspective. Even if the key findings and challenges as well as the nine individually discussed topic areas all raise completely different issues, they are still very much interrelated. They ultimately illustrate the necessity of coming to terms with these topics individually, and as a whole, not least in how they increasingly relate to one another moving forward. This holds true for all stakeholders in a mobility fulfilment system.**

# THE PRINCIPLE

## “MÜNCHNER KREIS Future Study”

The past years have been characterised by what is often described with the catchphrase “digital transformation”: transformation or disruption – which mustn’t be interpreted as merely the use of new technologies, but instead refers to profound upcoming changes in thinking, a breaking with traditions, and a rethinking of almost all of our routines, processes, and operational strategies.

Keeping one’s bearings in this environment, with its mix of change, loss, and awakening, is exceptionally challenging. And decision-makers in politics and business aren’t the only ones being forced to face these challenges; individual citizens are challenged with questions about the future regarding their own capabilities and know-how, as well as the continued existence of individual and commonly shared values.

**With a view to digitisation’s economic, social, and political relevance, the MÜNCHNER KREIS has been dealing with this future study concept since 2008 to provide orientation in the digital transformation.** To fairly evaluate digital trends, the MÜNCHNER KREIS Future Study approach has looked to the expert view, based on empirical data, and examined it to reach a critical and unifying economic and social perspective.

This is the first time the focus has been on a single field of application: **the topic of mobility. Looking at the questions of future mobility fulfilment 2025+, the 2017 Future Study addresses one of the central economic and social challenges of our time. There is hardly any other sphere of life or industrial sector where the consequences of digitisation are so difficult to predict and will be so extensive.** A look at Germany and Europe shows that much will be at stake for the future, particularly in this sector – both economically and socially.

It was important for the MÜNCHNER KREIS and its partners to consider mobility as a systematic whole, moving beyond isolated future concepts and future scenarios to emphasise interdependence and cause-and-effect relationships. The central elements for a “functioning” mobility in the future were discussed under the deliberately unwieldy term “mobility fulfilment systems”, which will arise from a combination of mobile and digital sources. They were transferred into a conceptual framework that informed the empirical survey and evaluation.

From the beginning, the intrinsic principle of this series of studies has been to think about and approach future research as an iterative process. Over the course of this process, findings and results are repeatedly discussed, refined, and ultimately consolidated into insights and outcomes. This process always has the objective of illustrating the specific opportunities and development potentials that arise for business and society. The results and findings are developed through various methodological approaches and reciprocally placed in relationship to one another and the discourse

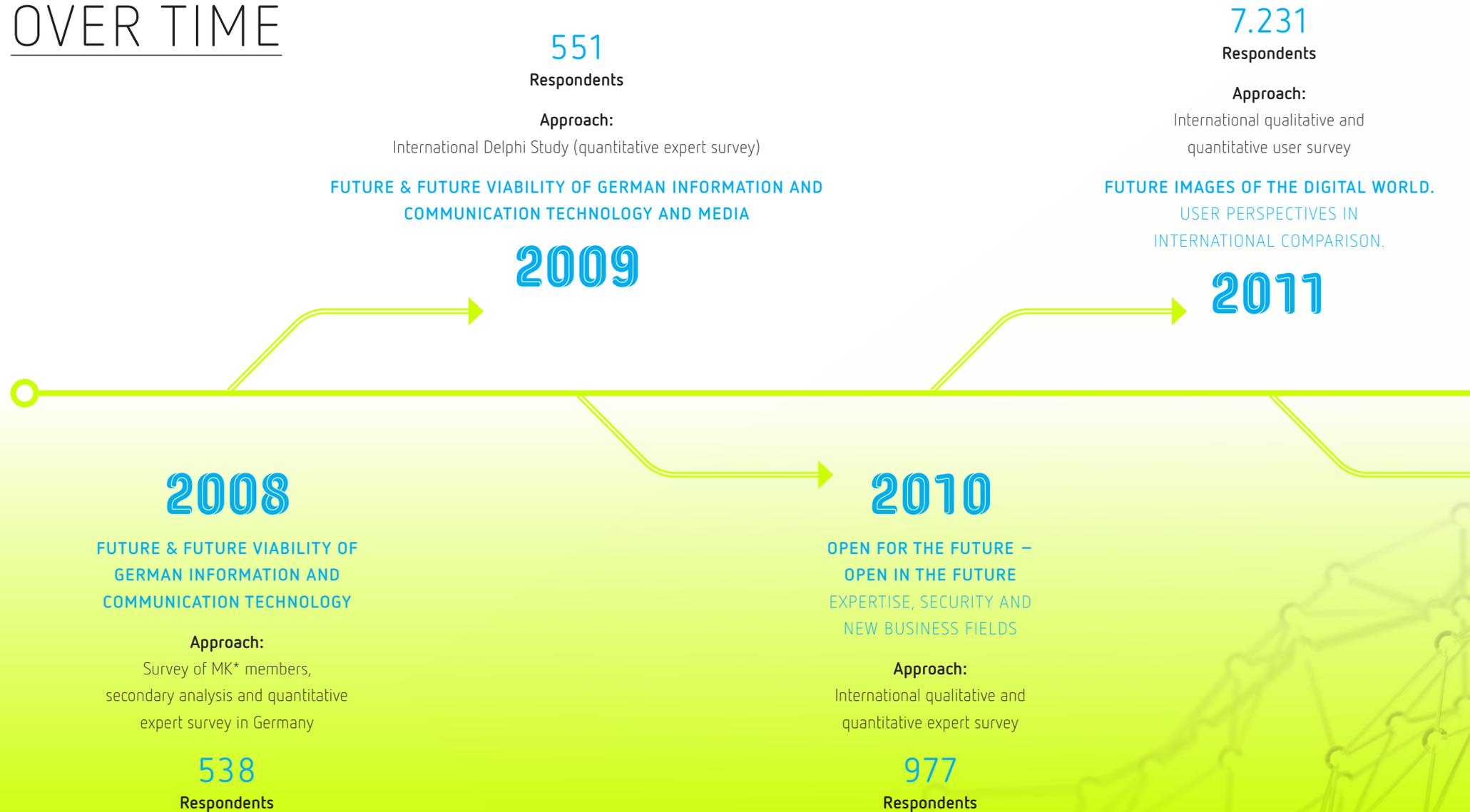
This distinctive methodological variety for this year’s Future Study is demonstrated in the combination of quantitative and qualitative analyses, and remains consciously cumbersome. The image of future mobility is incomplete yet multi-dimensional, as was shown by the comprehensive Delphi expert questionnaires, numerous expert workshops, and the final international survey. Therefore this year’s Future Study includes future concepts, statements on trends, and provocative visions, as well as condensed analyses on important fields of action for the mobility of tomorrow.



**Providing orientation means figuring out the map and pointing out potential paths. Not surprisingly, there is more than one road leading to mobility’s future. We invite you to take the plunge with us and find your way.**



# THE "FUTURE STUDY" PROJECT OVER TIME



7.278

Respondents

**Approach:**

International qualitative and quantitative user survey

**INNOVATION FIELDS  
IN THE DIGITAL WORLD.**

THE NEEDS OF THE DAY AFTER TOMORROW

2013

498

Respondents

**Approach:**

Delphi study with 29 international experts (online), eight expert workshops, and a quantitative survey

**MOBILITY. FULFILMENT. SYSTEM.**  
ON THE FUTURE OF MOBILITY 2025+

2017

2012

**MÜNCHNER KREIS  
FUTURE WORKSHOP 2012**  
END-CUSTOMER INFLUENCE  
ON B2B VALUE-CREATION PROCESSES

**Approach:**

Expert Workshop

50

Participants

2014

**DIGITALISATION: ACHILLES' HEEL  
OF GERMAN BUSINESSES?**  
PATHWAYS TO THE DIGITAL FUTURE.

**Approach:**

Quantitative expert survey (online) plus eight expert workshops (with a total of 36 partners)

517

Respondents

# METHODOLOGY PROFILE

The methodological approach of the “Future Study MÜNCHNER KREIS” project is multi-perspective and transdisciplinary. A large-scale Delphi study among international mobility experts forms the qualitative core, which is supplemented beforehand and afterwards with additional qualitative and quantitative research phases.

The goal of this project is to better understand how the mobility “of tomorrow” will change in the course of technical, economic, and social developments over the coming eight to fifteen years, which consequences this can have for the various elements of mobility, and which specific recommendations for action for the various stakeholders can be recognised. The research process is based on a systematic view of the question of how the demands on our mobility and on the mobility systems required to fulfil them will change in the future. The entire research process can be arranged in the following phases, some of which ran in parallel:



## Development of fundamental systematics

### PREPARATION WORKSHOPS WITH STUDY PARTNERS:

#### 1. Partner Workshop (Kick-Off, 08.04.2016 at TU Munich)

Partners' visions about the mobility of the future compiled

#### 2. Partner Workshop (31.05.2016 at TU Munich)

Mobility fulfilment system developed and filled out with the partners' visions

#### 3. Partner Workshop (14.07.2016 at TU Munich)

Visions fleshed out, preparation of the first wave of Delphi surveys

→ The goal of the first phase was to develop a classification that described the entire field of mobility. This consciously cast a very broad net for the potential of considering mobility with all its problem areas and the solutions relevant for these. With the aid of three workshops within the group of heterogeneously assembled project partners and with accompanying desk research, system levels were next identified to examine the changes in mobility fulfilment systems. These changes were looked at in an all-encompassing manner. This produced the wide range of economic, social, technical, and regulatory topics that were discussed in the workshops.

The goal of the first workshop was to collect the study partners' visions and ideas about future mobility. The mobility fulfilment system with its system levels was conceived in the second workshop and given substance and life with the aid of the partners' ideas. The third workshop further specified the future mobility ideas and prepared the first wave of Delphi studies.

# 2

## First wave of the Delphi study

### 1. DELPHI WAVE

(22.07.–01.08.2016)



→ The system levels constituting the mobility fulfilment system served as the regulatory framework for the first wave of the Delphi studies. Experts discussed the individual, relevant elements of Mobility 2025+ using these levels. The partners selected 26 international experts from 12 countries for the first Delphi survey, who then described their visions, ideas, and expectations for future mobility fulfilment systems to the year 2025+.

The system levels and a series of emotive terms served the experts as both stimuli and as a guide. On the one hand, this gave the experts orientation as regards the contents. On the other hand, it laid out the creative aspects in the survey.



## Consolidating the input to topic areas

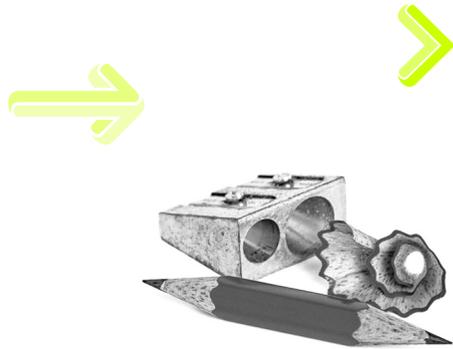
### DELPHI PUSH (31.08.2016)

Partitioning of the study through partner input across nine topic areas, development of the future concepts from the input of the first Delphi survey for the second Delphi survey (per topic area)

→ The discussion results from the partner workshops were analysed for content and concentrated into the nine topic areas in parallel to the first Delphi survey. The first step was coding the statements from the workshop participants.

Coding the contents facilitated subsequent identification of the topic areas. The results of the first wave of the Delphi survey were analysed for content and the topics enhanced with the analysis results. The synthesis of the workshop and Delphi results showed how valuable the heterogeneous assembly of the circle of partners for the future study was.

Next followed the development and textual description of the so-called future concepts, based on the expert contributions from the first Delphi survey. This made specific future images of the mobility of the future, with its obstacles and potential, available to decision-makers. Every future concept represented a synthesis of the results from the first wave of the Delphi survey and addressed one of the nine topic areas.



## Second wave of the Delphi study and consolidation

**2. DELPHI WAVE** (23.09. – 09.10.2016)

### PROCESSING THE RESULTS:

#### 1<sup>st</sup> Results and Editorial Workshop

(26.10.2016 at Bosch in Stuttgart)

Presentation of the results of the second wave and start of text creation

#### 2<sup>nd</sup> Results and Editorial Workshop

(08.12.2016 at Fujitsu in Munich)

Development of main focuses per topic area

#### 3<sup>rd</sup> Results and Editorial Workshop

(03.02.2017 at TU Munich)

Presentation of the developments, intensification of the focus areas into theses about mobility of the future, and questionnaire development for quantitative validation

→ In the second wave of the Delphi study, the experts were asked to evaluate and comment on the future concepts. A total of 22 international experts took part in this second study. Every expert evaluated three or four future concepts so that every future concept was evaluated by nine experts on average. The results were consolidated at the end of the Delphi study. Based on the collected results, three editing workshops each defined three topics that formed the contextual focus for a topic area's development. The working results were continually honed in an iterative process, resulting in one central thesis per topic area.

4

5

## Empirical validation

### QUANTITATIVE VALIDATION OF THE NINE THESES FOR MOBILITY OF THE FUTURE

(28.02. – 06.04.2017)



→ These nine theses formed the starting point for the validation within the scope of an internet-based survey of 498 mobility experts worldwide. This was the only way to guarantee that the results developed within the study's framework were sufficiently specific to be able to work out feasible recommendations for action for stakeholders in business, science, and politics.



## Development of recommendations for action

### RESULTS PROCESSING:

#### Final Editing Workshop (30.03.2017 at Kantar TNS in Munich)

Presentation of the study, including layout and design

→ These recommendations for action represent one of the study's many significant results. Ultimately they are based on the results of partner workshops, the two waves of the Delphi study, and the empirical validation. This professional and scientific/methodological foundation can and should assist in better understanding the future challenges for mobility and allow necessary decisions to be made in a timely manner with the adoption of necessary measures.

6



## THE STUDY IN NUMBERS

35

**experts in the workshops**

(Business partners, MÜNCHNER KREIS, project team & Chair for Information Systems)

29

**different experts in the Delphy study**

(Wave 1: 26 experts; Wave 2: 22 experts)

12

**countries of origin for the experts**

Germany, United States, South Africa, United Kingdom, Mexico,  
Slovenia, Canada, Finland, Switzerland, Taiwan, Austria, Japan

498

**participants**

in the qualitative validation

# MOBILITY FULFILMENT

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## 2025+

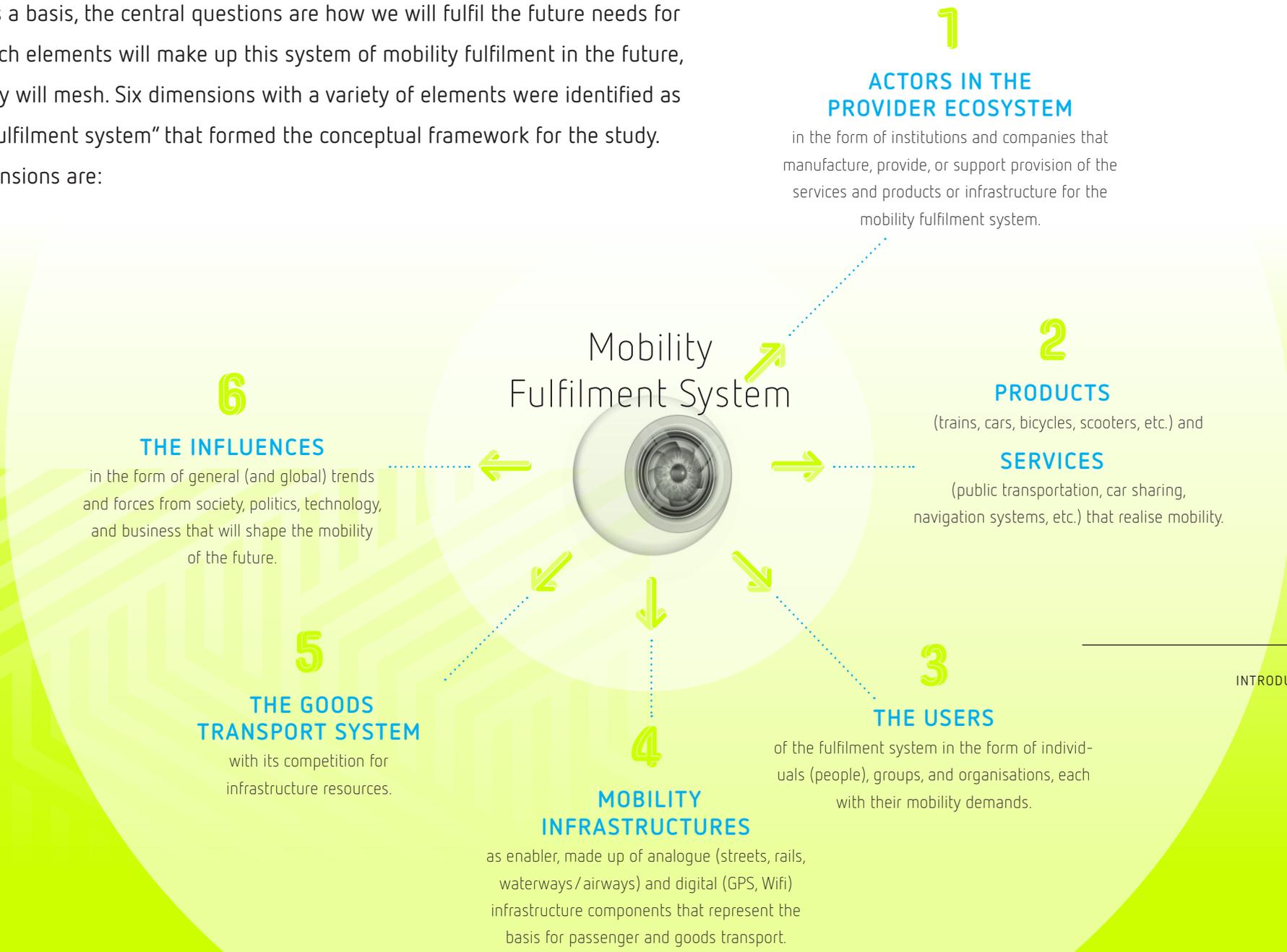
### Introduction

Since the beginning of the decade, a vast number of studies have been devoted to the future of mobility. More than forty studies on this topic have been published since the end of 2015 alone.

These studies focus mainly on specific, delimiting ways of looking at a problem. One core theme is ramifications for the automobile sector. While a few authors have delved into the technical aspects of mobility – including fascinating discussions about the problems of communication between autonomous modes of transport in real time, or autonomous driving in general – others focus on economic aspects. The influence of various developments in transportation modes on each other and their influence on other sectors, such as retail or media, is rarely considered. In this respect, these studies make important contributions for focussed discussions on the topic of future mobility; however, they don't help decision-makers grasp the changes in mobility in all of their complexity and across the wide diversity of topics.

Notably, as of yet there has been no comprehensive analysis of the interactions and correlations between mobility's technical, economic, social, political, and legal aspects. This is unfortunate because given mobility's increasing complexity, more thought should be spent on networking in this field: of market players in flexible value-creation networks; of mobility services in multimodal solution packages; of traffic and user data in models of predictive analytics; of analogue and digital roles in hybrid mobility structures. The answer to the manifold challenges, especially those caused by mobility's digitisation, can accordingly not be found in only one solution, but instead must be a pluralism of networked solutions that function together as a system. The core of this system is composed of the standardisation and availability of common, ubiquitous services and platforms. The driving force, however, will be users' trust in the quality, security, and dependability of the solutions. The partners of the MÜNCHNER KREIS Future Study agree that the key for the successful shaping of the mobility of tomorrow is found in exactly this integrated approach – a mobility that reconciles the economic interests, ecological framework, and society's demands.

Using this as a basis, the central questions are how we will fulfil the future needs for mobility, which elements will make up this system of mobility fulfilment in the future, and how they will mesh. Six dimensions with a variety of elements were identified as a “mobility fulfilment system” that formed the conceptual framework for the study. The six dimensions are:



The study takes up the mobility fulfilment system across **nine topic areas** and comprehensively considers it within each one. The topic areas are based on the partner workshops and the first Delphi survey. Both the discursive expert workshops and the experts' texts were analysed for content and consolidated into clusters. The topic areas arose from these clusters and the lines of argumentation from the weighted relevance of the textual citations in the individual chapters.

#### TOPIC AREA 1

**"Mobility data as currency: between property, transparency and added value"** deals with the role of user-related data for the development and establishment of innovative, efficient, and attractive mobility services, and questions whether mobility in the future can be realised without the wide use of user-related data.

#### TOPIC AREA 2

**"Mobility without a digital divide"** looks at the challenges to the use of innovative mobility solutions stemming from the different ways the population accesses and deals with information and communication technologies.

#### TOPIC AREA 3

**Real-time mobility marketplace: radical change in value creation"** examines the changes in competitive conditions for the mobility of the future caused by digitisation.

#### TOPIC AREA 4

**"Changing the political understanding of infrastructure"** discusses the role of supply infrastructures for the implementation of sustainable mobility concepts, and explores to what extent the established understanding of infrastructure is getting in the way of necessary infrastructure revolution.

#### TOPIC AREA 5

**"Challenges for mobility systems in change"** is concerned with how established and new mobility solutions can be meaningfully interlinked to avoid thinking in either/or categories.

#### TOPIC AREA 6

**"Traditional mobility providers lose direct contact to customers"** identifies the direct interface to customers as the first criteria of differentiation in competition between new and established mobility providers, and is concerned with factors affecting customer contact and loyalty in the mobility marketplace of the future.

# Cross-Cutting Issues

Four “big issues” are integrated into the individual topic areas: data, economics, security, and regulation. They cut across the argumentation in a series of topic areas.

## TOPIC AREA 7

“**Added value drives mobility**” broaches the issues of transport functions such as flexibility, ease of use, and speed, as necessary but insufficient prerequisites for a mobility offering’s success.

## TOPIC AREA 8

“**Potential for mobility avoidance**” questions future mobility needs and considers the potential of new, digital technologies for avoiding physical mobility.

## TOPIC AREA 9

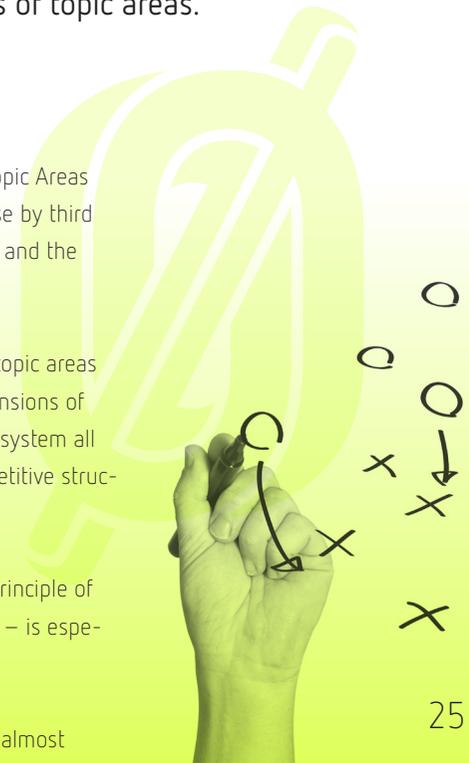
“**Goods transport in radical transformation**” analyses how the barriers between transporting people and transporting goods can be removed to alleviate pressure on traffic infrastructures over the long term.

**The cross-cutting issue of data** is particularly relevant for Topic Areas 1 through 3 with a view to the challenges and potential of data use by third parties in a mobility ecosystem, the control concepts for data use, and the economic considerations of accessing user data.

**The cross-cutting issue of economics** extends through all topic areas of the mobility fulfilment system conceptual framework. The dimensions of services and products, users, and stakeholders in the provider ecosystem all dovetail into the aspects of efficiency, the transformation of competitive structures, and new service concepts and business models.

**The cross-cutting issue of security** – data security as the principle of data privacy, and the regulatory security of new mobility concepts – is especially addressed in topic areas 1, 3, and 4.

As with economics, the **cross-cutting issue of regulation** is almost universally present across the topic areas. Fundamental questions addressed include the right to one’s own data, supplying basic mobility services in a digitised mobility ecosystem, and the financial support for innovative infrastructure components.



# READING AID

## 1

The following chapters are all organised along the same lines: each chapter is introduced by a triad of:

- a **thesis** that describes a particular development of a mobility fulfilment system;
- a **finding** whose causes are described, and;
- a **recommendation for action** that illustrates an approach towards the future handling of the situation described in the thesis.



## 2

Before the actual discussion of the topic area, each chapter ventures to look ahead to the future of mobility. The **future concept** describes a specific issue for the respective topic area and **suggests a solution**. The probability of occurrence and the concept's feasibility are subsequently discussed.





The detailed examination features:

- a more detailed **introduction** to the topic, and;
- a discussion of the **challenges** that politicians, businesses, and society will be faced with in the respective context.

One of the **key statements** for each chapter will then be validated by the **results of a survey of international mobility experts.**

**4**



**5**

Each chapter closes with an overview of **possible actions** that can meet the challenges.

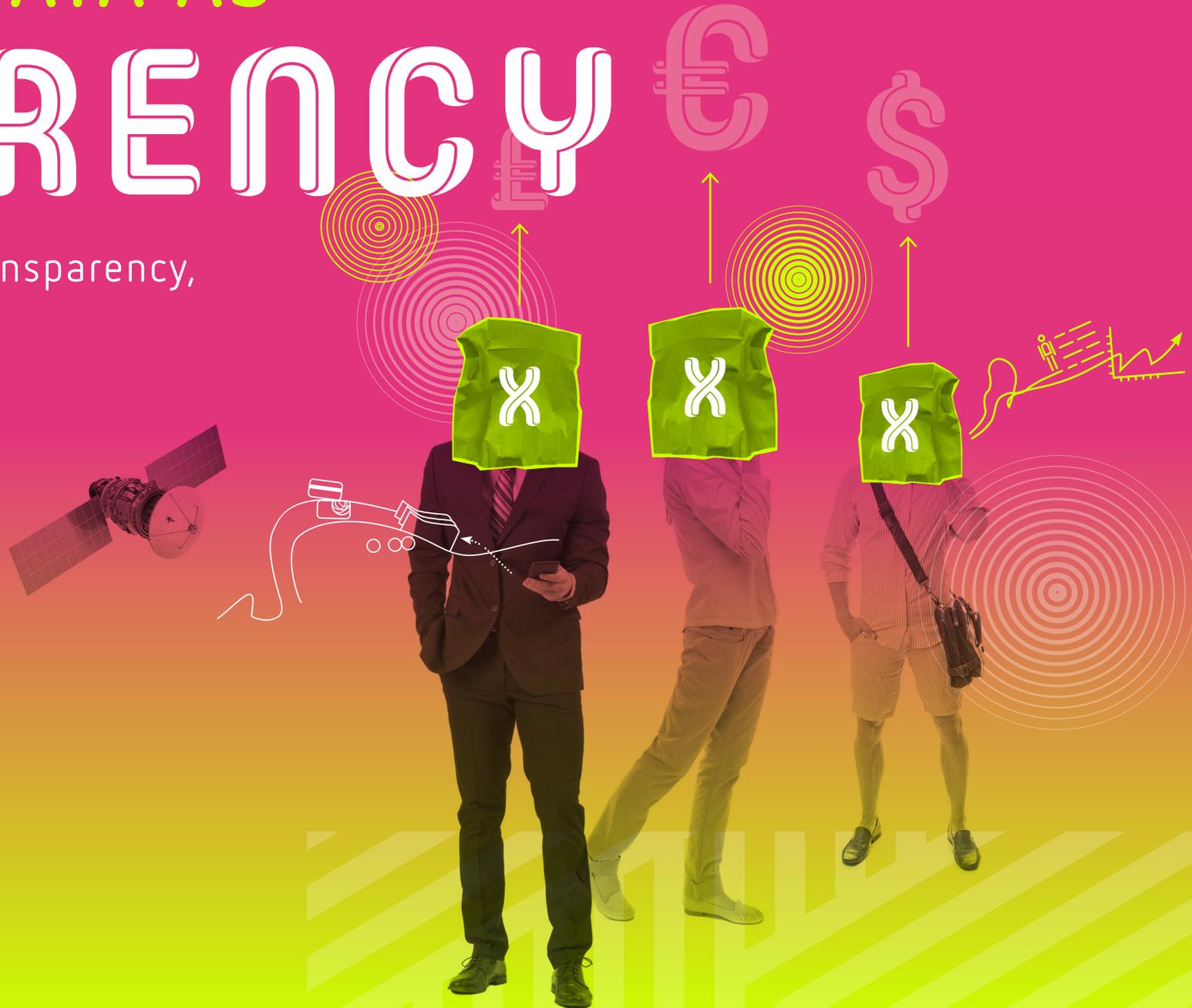


MOBILITY DATA AS

# CURRENCY

Between ownership, transparency,  
and added value

TOPIC AREA





ANONYMITY IS AN ILLUSION!

› THESIS



FUTURE MOBILITY WITHOUT  
THE USE OF PERSONAL DATA  
WON'T WORK!

› FINDING

THE ESTABLISHMENT OF EFFECTIVE,  
UNIFORM REGULATIONS FOR EUROPE.

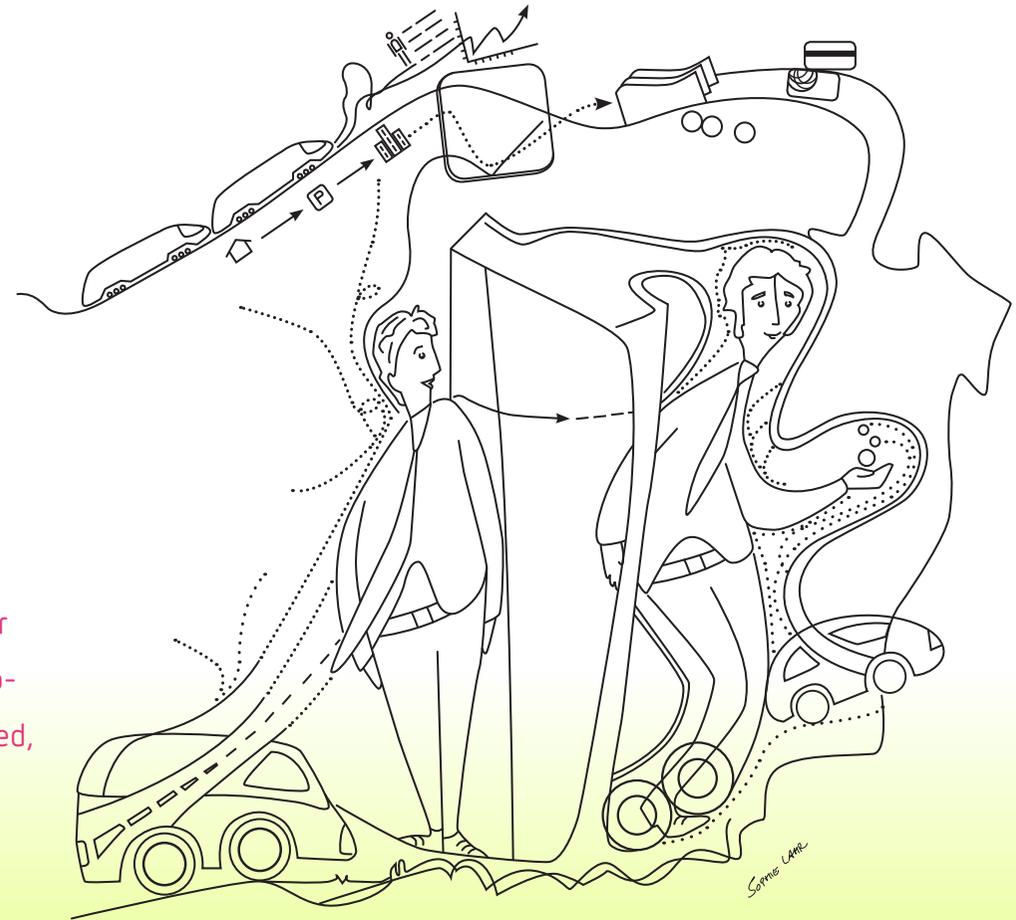
› RECOMMENDATION FOR ACTION



# FUTURE CONCEPT

In the year 2025, user data will be the foundation for nearly every mobility offering. Many users have absolutely no idea what data is being collected and utilised, and are happy to provide their data in order to get cheaper fares or to be able to make use of services customised to their specific needs.

Digital assistants will be used in the future to control and manage personal data. These assistants also allow the use of data as currency. Customers will have several possibilities to choose from for a journey from a suburb of Munich to Berlin's city centre: first, a variety of personal data (for instance calendar, destination, purpose of the trip) can be used to pay for the journey, or, second, as was the case previously, the trip can be booked and paid in a conventional manner to enable anonymous travelling. Third, many types of intermediate forms are also possible. Conflicts about the use of personal data will play barely any role in the future.



There will be regulations for data protection through the anonymised use of data or for its use with the users' explicit permission. Yet data can create very high efficiencies for traffic management and individual mobility over the short term. This is why data protection regulations will often not be adhered to since commercial, public and individual value creation predominate.



COMPANIES ALREADY COLLECT  
A LOT OF DATA THESE DAYS,  
AND THEY WILL BE COLLECTING  
EVEN MORE IN THE FUTURE.

TODAY AND IN THE FUTURE,  
CUSTOMERS WILL NO LONGER HAVE  
FULL CONTROL OF THEIR DATA.

**# PROBLEM**

### ⇒ Experts' Evaluation of the Future Concept

A majority of experts feel confident that this future concept will occur. One thing that speaks for this development is that smartphone users today already share a lot of private data, for instance on social media, without having knowledge about the data collection and how that data is being used. This also applies to online shopping, for instance when providing credit-card data. The liberal sharing of data follows the reasoning of receiving customised information and services as measured against the individual requirements.

The availability of user data will make it possible to continually refine mobility concepts to better meet user demands. The use of digital assistants to support this process will meet with acceptance by users; however, the concern remains that even digital assistants will be unable to protect the user from data misuse. Particularly critical is that data protection regulations and the use of personal data in practice are increasingly diverging from one another without users perceiving this as a drawback.

### ⇒ Feasibility of the Future Concept

According to the experts' assessment, the future concept's feasibility is determined by three factors. One factor is the ability and will of lawmakers to enact enforceable regulations that guarantee users' ability to control their personal data and make the use of personal data by third parties traceable.

A second factor is the establishment of a mechanism for calculating the value of personal data. The set-up of a "data exchange" is proposed through which the specific value of a user's personal data is determined. The rules for consent to using the data must be regulated at a national and international level. The third factor is successful education of users as regards the additional benefits they receive in connection with the disclosure of their personal data. Broad social acceptance of data use is fundamentally necessary for this. This requires action by mobility services providers and data dealers, associations, and politicians.

# 1

## MOBILITY DATA AS CURRENCY

Between ownership, transparency,  
and added value



Navigation systems are a common component in cars these days and have largely replaced paper road maps. Other road users such as bicyclists and pedestrians increasingly rely on digital maps and path-finding apps connected to or as an integral part of their smartphones.

For offline use, the devices and services work autonomously, based on the received GPS positional data. Additional data exchange doesn't take place. However those services for which the device is online and has a wireless connection are much easier to use, and current traffic information or other information about the surroundings can be called up from the cloud. If the user additionally shares his or her information and allows its transmission to the web, this opens up completely new value creation potential by way of personal, user-specific services and applications. The spectrum of possible "own data" is very broad and can include the entire context, the user's current surroundings, and/or the characteristics of that person's current mobility situation.

**The positional information is complemented by the personal identification, requests for routing, the selection of the means of transport, or alternatives to paying for offerings.** Some data will be automatically acquired and passed along (e.g., vehicle data in case of interruptions or malfunctions for online diagnostics) while other data will be consciously shared.

*»The digital identity and trusted ability to negotiate with it will be assigned to a variety of smart assistants. Identity management and its protection will become even more significant in the future.«*

As with shopping on the internet, users have no awareness of which data is being collected and used at what point in time. They are mostly unconcerned about sharing their data in order to rapidly take advantage of these services. What's more is that providers frequently call up data about users from other services and combine this data with one another, which leads to a new, completely non-transparent depth of information about users and their behaviour. The creation of data and use of data are thus becoming increasingly decoupled. What happens with the data is no longer easily understandable, let alone controllable.

While some innovative convenience services are fee-based and are paid in advance or for each online use, it's expected that services will increasingly be offered free of charge inasmuch as users supply certain data for it. Customers pay for the service with their data. Personal data as a rule will be used as a means of payment. In contrast to traditional money, this currency is usually no longer anonymous but instead connected and/or connectable to the users' identity. On the one hand, this data is valuable for the mobile users, who receive offerings and information customised to themselves and their location and – apparently – pay nothing for it. On the other hand, this data is valuable to the service provider or third parties to whom the data is passed along. From the positional data and the context delivered with it, providers can then send current offers, tailored exactly to the individual users.

The service providers and/or third parties benefit from this directly or indirectly by doing business with the mobile users or being able to initiate such business. Offerings that are particularly attractive are those customised to the individual users and their situation at the moment, or those that can realise appreciable cost benefits for the users. For instance, sharing certain personal mobility data could allow users to receive better rates for vehicle insurance.

*» Mobility makes the development of a society both visible and tangible – for empowerment or for a cybernetic, coercive system of technologically disguised paternalism. «*



**Digital assistants will serve to control and manage personal data in the future. This will be particularly interesting for more complex mobility situations and demands, for instance when planning and booking longer trips with the use of integrated, multimodal transport services.** A variety of personal data (e.g., calendar, destination, purpose of the trip, preferred transport type, desired sightseeing spots) could be used to pay for the trip. More or less autonomously, the smart assistants will use the user data as payment. To enable more anonymous traveling, traditional booking and payment would still be possible. There will be hybrid forms combining both models as well.

# 1.1

## CHALLENGES



### What level of transparency is wanted and how can it be achieved?

Mobile users perceive a variety of benefits when they surrender personal data, especially when they can use free or reasonably priced services for it in exchange, or it contributes to a service being offered in the first place. So they trade personal data for services and use their data like money. For data monetisation, a distinction should be made between mobile users' "master data" that changes very little over time and volatile data (such as the current location). The former – in contrast to real money – quickly lose value once they have been given away.

As a rule, however, users don't know which data is actually flowing at the time of the data transfer, nor whatever else happens to it, let alone to what extent this data is transferred to third parties, and how it is processed and combined with other data. What is more: often no one even cares – the main thing is that the service works. In contrast, surveys find that privacy protection is mostly considered very important. This so-called privacy paradox, which also applies to other digital applications, demonstrates the observed contradiction between aspirations, meaning a high degree of data protection, and actions, meaning the "blind" use of services.

Preserving privacy will remain relevant for a number of users. This group may be more prepared to surrender their data if they are given transparency about its use. This is particularly the case for personal data that lifts anonymity. Since it is likely that the use of anonymous personal data can only be guaranteed to a limited extent in the future – due to advancing big data analytical methods – the demand for transparency will become an even more important issue. Societies are expected to insist on "mutual transparency": the "transparent user" stands in opposition to the disclosure of the type of data use or "usage transparency" on the side of the provider. The relationship between users and providers does not appear symmetrical. While users do receive an exchange value for their data, for instance a mobility service, it ultimately remains difficult to impossible for individuals to reach a conclusion about the appropriateness of the "price".

Last but not least, the topic touches upon the area of public safety. Police and other law enforcement agencies occasionally demand access to user data such as a mobility profile. This results in a conflict between the citizens' (meaning the users') desire for safety and the protection of their privacy. This creates a paradox in view of the growing disclosure of private data in exchange for useful applications: some users resist government agencies being able to look at such data, but are generous with private commercial providers.

Exactly how far transparency can go and must go for the use of data by operators, platforms, etc. is unresolved. As of yet, there are technical limits to tracing data usage, particularly as the "subsequent use" (linking this data with other data, or the data being passed on to third parties) is much harder to track and to document than the first use is. Thus doubts exist about whether the deletion of personal data (a "digital eraser") is even possible, and if so, to what extent.



## How much is our data worth (to us)?

If data is to be used as a currency, then it has value – for the provider and for the receiver. But is this value quantifiable and is it constant? **The value of personal data undoubtedly varies, and not just from application (service) to application.** The value of positional data can be very high should an accident occur while underway, but otherwise it remains comparatively low. But it also depends on the individual to estimate the data's value. So it is important to correctly judge the significance and the value of one's own data. Yet the determination of the data's value is very difficult due to the inherent dynamic over time.

And if someone has given away their data to a service partner, additional questions arise: Is the data also interesting and valuable to third parties? What if this third party has already acquired the data in another way?

A proposed solution for the dilemma of valuation is found in a yet to be created "data exchange". To achieve this, data companies must assign a value to the respective data, a value based on their business models, that is largely transparent and generally accepted. This value can fluctuate on the exchange. Complicated reconciliation processes between the various data companies could be avoided in this manner. Whether this approach is feasible in view of the data that can already be found "out in the field", and the global characteristics of this problem remains to be seen.

It might be more important to heighten users' consciousness about the value of their data. For instance, public campaigns in networks and on television could be effective for this, such as has been practiced for road-safety measures (i.e., compulsory seat belt use).

*»Users must recognise a measurable benefit before agreeing to the collection and sharing of personal data.«*

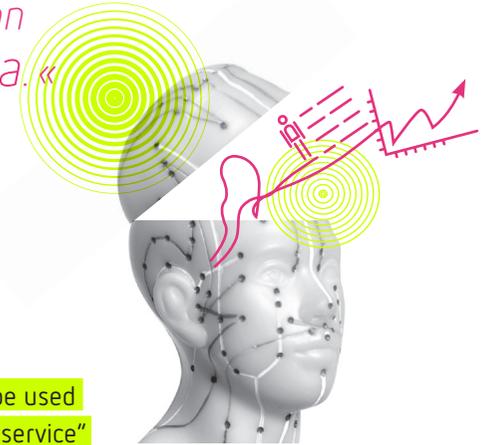
▲  EXPERT

**People must know that collected and exchanged data can be used for "smart" mobility services and to generate "lifestyle as a service" profiles.**

This goes far beyond the world of mobility services. Day-to-day life can be organised around the clock with optimised services, with their inherent advantages and disadvantages, including convenience vs. restrictions on freedom of choice.

This is an educational issue that must be addressed early in schooling. In a similar manner to learning numbers and mathematics, or "reading and writing", the "use of my data" should be taught and learned. This knowledge should be limited to the basics because the layperson need not understand the complexity of the processes and transactions taking place, for instance the linking of data by means of artificial intelligence. The laypersons should be able to grasp the dimensions of what is happening and make decisions accordingly.

It is also important to explain that it often isn't necessary to disclose personal data to be able to use a service, even mobility data. Thus, there is a need for solutions that allow users to remain anonymous if they wish to. In view of the previously mentioned dramatic progress in methods for data analysis, the problem of anonymity becomes even more difficult.



## TO WHAT EXTENT WILL IT BOTHER USERS THAT THEY WILL HAVE TO GIVE UP THEIR PERSONAL PRIVACY?

→ *Three different perspectives collide in reply to this question. One group of experts believes that people must concede to being transparent users, followed at every turn. This is the price for individual mobility offerings that offer added value and comfort/ease of use. The second group believes that users won't resign themselves to relinquishing their privacy. Transparency about the use of personal data will be the prerequisite and foundation for new offerings in this scenario. Giving up privacy must definitively be paired with adequate benefits. These benefits must be understandable and correspond to the individual value systems. The third group assumes that users won't give up their privacy at all, but will instead define new private protected spaces. The willingness to transfer data will be different for each individual and is influenced by the values, attitude, environment, and their previous assessment of the protection personal data merits.*

▲ **+** ADDITIONAL QUESTION FOR THE EXPERTS



## Which types of regulation do we have and which do we need?

Various interests come into conflict for the collection and use of mobility data. Users want efficient services but also want to know their privacy is being protected, providers want to offer new services and do business, and even the state occasionally needs to examine data. This means it is at least partially a responsibility of lawmakers and/or regulation to prevent these potential conflicts from occurring or to resolve them if they do. **Akin to street and road traffic, or commercial transactions, regulations are required that guarantee individuals' rights to their own data ("informational self-determination"), which is part of their identity.** Users should be allowed to see what data about them is or was being captured and stored, and where. It must also be ensured that third parties – "outsiders" – cannot easily access this data. In principle, the use of personal data without the consent of the original owner must be prohibited, comparable to the unauthorised use or stealing of physical objects. From a legal standpoint, this is a "prohibition subject to the right of approval".

Last but not least, the traceability of any access must be guaranteed. This questions who owns the data at any point in time. Does the paradigm of "my data is my property" even hold true? Could copyright law be relevant because data can be arbitrarily reproduced? Considering the global character of the services (service provision frequently takes place abroad), national law is limited in its reach. Regarding data protection, initial measures have been taken with the new European General Data Protection Regulations (GDPR-EU). The regulations are supposed to standardise data protection laws across the EU. Among other things, it regulates the legal basis for data processing, the rights of concerned parties, and the obligations for those responsible. The rights of concerned parties that already apply have been expanded and supplemented with new rights (e.g., the right of data portability and the "right to be forgotten"). The GDPR also applies to companies that are headquartered outside of the European Union with services targeting EU citizens ("*lex loci solutionis*" or "law of the place where relevant performance occurs"). Meanwhile, the regulation, which comes

Expert Question (498 respondents):

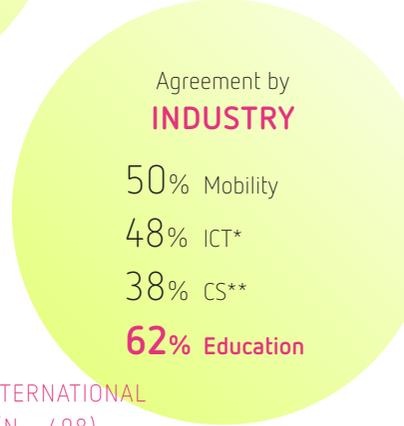
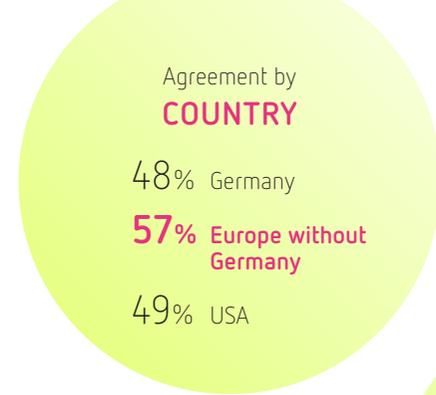
# INNOVATIVE MOBILITY SOLUTIONS WILL ONLY BE SUCCESSFUL WHEN THE USE OF PERSONAL MOBILITY DATA IS SAFEGUARDED BY LEGAL PROVISIONS.

→ All questioned mobility experts (n = 498); the missing value to 100% = no answer; the proportion of agreement is represented as "Top 2" answers ("Agree completely", "Mostly agree")



into effect in May 2018, is facing significant criticism from all sides. Data privacy activists criticise (among other things) that the GDPR ignores modern developments such as social networks, big data, search engines, cloud computing, and the Internet of Things.

The biggest challenges for implementing the GDPR in Germany and in working out the revised version of the Federal General Data Protection Regulations currently being drafted is maintaining a balance between protecting the user's privacy on the one hand and avoiding restrictions that prove to be too difficult to surmount for current and future data-driven services.



52%

↑ OF THE INTERNATIONAL EXPERTS (N = 498) AGREE ("TOP 2")

27%

21%



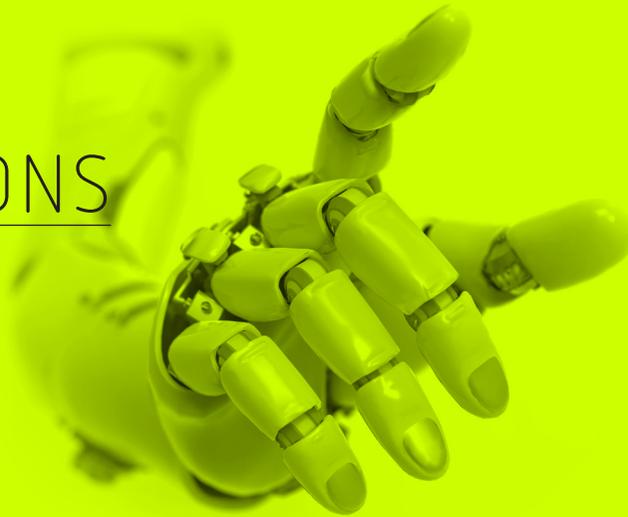
1 / 37

MOBILITY DATA AS CURRENCY

\* Information and communication technology  
\*\* Corporate services

# 1.2

## RECOMMENDATIONS FOR ACTION



### RAISING AWARENESS ABOUT DATA SOVEREIGNTY

Schools and training facilities are and remain the central locations to develop a better “data consciousness” for citizens. They must receive the funds and skills for this educational mission. Massive publicity work by national and private agencies is just as important for drawing greater attention to the problems and good behaviour practices with the help of video clips, etc. than has previously been the case. Innovative communication methods are required, which could include game-based methods, such as tracking the use and exploitation of my data as a “data adventure” with which younger users in particular could learn how to handle data.

Yet it is important to emphasise that educating and training for the “smart digital world” must not be confined to simply equipping schools and other educational institutions with computers or offering programming courses. Instead this is about understanding important general relationships, dependencies, and processes, especially those where massive personal data plays a role. Ultimately this is about awareness of the value of free will in a democratic society for the success of self-determined use of the rich diversity of digital technologies. #



## R&D EFFORTS FOR MORE TRANSPARENCY

A lack of transparency and traceability of the use of user data is probably difficult to overcome. Despite this, one of the key tasks remains searching for technical measures and developing solutions that allow users the greatest possible access to their personal data inasmuch as this is wanted by the individual. Preferably this would be through workable procedures with which the data transfer or the lifespan of personal data can be controlled.

As a result, use of services cannot become too complicated. To this end, relevant R&D efforts are required. New technical solutions must be accompanied by the international standardisation of technical interfaces, data formats, protocols, and other operations. #



## LEGAL FRAMEWORK FOR EVALUATING MOBILITY DATA

The legal evaluation of mobility data – both personal and non-personal – must be undertaken. Provisions must be made for cases of infringement of the legal regulations. While the legal foundation for the use of personal data has been created at the European level through the General Data Protection Regulations, this now must be implemented at national levels. The revised version of the German Federal General Data Protection Regulations must maintain a balance between protecting users' personal privacy and avoiding excessive restrictions on current and future data-driven services

Widespread applications such as social networks, cloud services, and the Internet of Things (IoT) must be addressed. New topics such as artificial intelligence, virtuality, and IoT will create completely new challenges. In light of the problem's global nature, further international harmonisation of regulations is imperative. Current or incipient oligopolistic and monopolistic developments must be controlled and/or prevented. #



# MOBILITY WITHOUT A DIGITAL DIVIDE

TOPIC AREA

40

# 2





"OFFLINERS" WILL BE LEFT BEHIND!

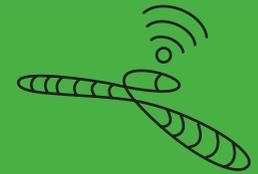
› **THESES**

FUTURE ACCESS TO  
MOBILITY IS DIGITAL.

› **FINDING**

CREATE AND COMMUNICATE BENEFITS.

› **RECOMMENDATION FOR ACTION**





# FUTURE CONCEPT

In the years 2025+, there has been a significant increase in the distribution and prevalence of digital services supporting mobility. Sharing offerings leads to a more economical distribution of means of transportation. The introduction of autonomous driving offers new opportunities for individual mobility.

Future mobility services are supported by numerous technological innovations that can be operated by digitally inexperienced users, for instance via fingerprints or with voice-operated systems. Easy-to-use offerings for multimodal mobility that are generated by personalised and situational digital services are more widespread and better in metropolitan areas; however they are no longer limited solely to these areas. Rural areas have extensive fast internet connections and have become more attractive with the advent of remote connectivity.



In the year 2025, there are transnational standards for the simple use and flexible networking of modes of transportation that leads to competition around efficient and user-friendly mobility services, and governmental regulatory measures have also led to nationwide provision of fast internet, even in rural areas.



MANY PEOPLE FEEL “LEFT BEHIND” BECAUSE THEY EITHER DON’T WISH TO PARTICIPATE IN DIGITISATION OR LIVE IN AREAS WHERE HIGHLY DEVELOPED MOBILITY SYSTEMS AREN’T AVAILABLE DUE TO A LACK OF DEMAND.

# PROBLEM

2 / 43

MOBILITY WITHOUT  
A DIGITAL DIVIDE



### Evaluation of the Future Concept

The experts tend to be confident about the second future concept. Against a backdrop of demographic changes – an ageing society – barrier-free access to digital mobility is required so that parts of the population will not be shut out of using new mobility services. Innovations to the human/computer interface, for instance based on artificial intelligence or voice-recognition concepts, will open up access to mobility offerings. Traditional divisions between mobility offerings in urban and rural areas will be counteracted by autonomous driving vehicles, which will allow basic mobility services to be comprehensively guaranteed, even in sparsely populated areas. Arguments against the future concept are, firstly, the necessity of the expensive expansion of high-speed mobile internet in rural areas. Secondly, innovations in the area of mobility are expected to alleviate traffic-related problems in cities. This will eliminate an important motive for living in rural areas, which in turn reduces the economic viability of mobility offerings in rural areas.



### Feasibility of the Future Concept

In order for this future concept to become reality, binding standards must be adopted and open platforms established that will form the foundation for realising the integration of various mobility offerings. Integrated mobility offerings should help to make living in rural areas more attractive and assist in avoiding rural flight. At the same time, the elimination of analogue access points must not result in people who are less skilled in the use of digital user interfaces being cut off from mobility offerings.

# 2

## Mobility Without a DIGITAL DIVIDE



The availability of broadband internet and the spread of mobile web-enabled devices are the essential prerequisites for future mobility to be offered via digital services. Digital services allow integration across a number of mobility service offerings, for instance by allowing intermodal travelling through the integration of public and private transport services. Many new mobility services can only be offered when all participants (providers, means of transport, and travellers) are digitally networked, such as station-independent car-sharing offerings that offer on-demand mobility around the clock for smartphone users. Such digitally available offerings can be shaped by the users themselves (as “prosumers”) since providers can either call up or calculate information about use, the vehicle’s condition, future demand, and much more.

Thus digital technologies represent the basis for the required networking and are the drivers for developing innovative mobility services. Access to these innovative mobility services is almost exclusively possible through digital channels. For location-independent sharing offerings, for example, there are neither ticket vending machines nor the possibility to reserve a car over the phone. Presently in Germany, there are around 17 million people (Initiative D21 – Digital Index 2016<sup>1</sup>) who don’t use the internet at all and therefore cannot access these services.

Digitisation offers many new possibilities for designing offerings, for financing, and for communicating with customers, whereby affordable and useful services may arise. First offerings for mobility completely financed by advertising are already on the market. One example of this is the “WelectGo” app of the Rheinbahn in Düsseldorf. This service rewards watching short advertising clips with a free single ticket on local public transport. Along with the digital infrastructure, it depends on the existing market, on the underlying profitability analysis by the mobility provider, and whether customers accept advertising- or data-financed offerings. This socioeconomic constellation determines whether attractive services in “my” mobility region are available and whether they are (can be) offered at affordable rates.

Whether the changeover to digital services actually succeeds will play a role for the future of supplying mobility. If it doesn't, another amplifying effect in the direction of a "digital divide" is to be expected in the area of mobility. This affects people who either cannot or don't wish to use the internet, and who will be blocked by access barriers or be shut out of parts of mobility, and will therefore have a direct financial disadvantage – whether it be due to voluntary or forced non-digital mobility behaviour.

Since mobility is a basic need for people, this begs the question of who will be responsible for supplying and paying for it in the future (public or private), what sort will be maintained, and, in particular, which degree of inclusion is aspired to. For this it is important to know how strongly the digital divide will impinge upon the mobility area of life. The decisive factor will be whether the mobility system of the future will be useable via avenues other than the digital, meaning accessibility is barrier-free and discrimination-free, so to speak. This results in three major challenges.

*»Implementing new mobility offerings must from the outset guarantee digital accessibility. Cell phone tickets and the elimination of ticket vending machines shut out marginalised groups...«*

▲  EXPERT



<sup>1</sup> <http://initiated21.de/publikationen/d21-digital-index-2016> (in German)

# 2.1

## CHALLENGES



*»The construction of facilitation laboratories ... is of crucial importance for this transition. ... The cities of Oslo or Helsinki might possibly take on this function.«*



### Create Access to Mobility for Everyone

The majority of mobility services in the year 2025 will only be available through digital channels due to the increasing availability of intra-urban sharing offerings, digital transport tickets, and mobility services only available digitally. **But even in 2025, there will be a significant number of people who either don't have or don't want internet access. These people will either be unable to participate in attractive mobility offerings – or only in a very limited manner, namely by using a private car.** It will be necessary to create alternative possibilities for access, particularly for people who are unable to use any digital avenues, without creating new administrative or financial obstacles. One example is the digital fingerprint with which mobility services in local public transport can be settled when traditional ticket vending machines no longer exist.

Users might have to accept higher costs for mobility – for instance when booking by phone is associated with additional fees. Providers who won't be offering multiple sales and distribution channels due to economic considerations could thereby establish insurmountable obstacles for the non-digital use of their services. Furthermore, which framework conditions are required to increase the acceptance of digital mobility services and to ideally reach all sections of the population must be clarified.

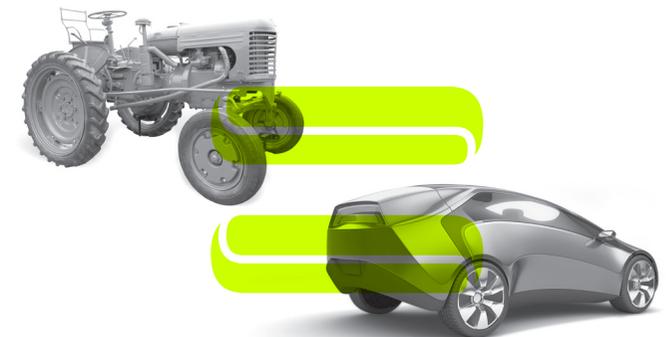


## Guaranteeing Affordable Basic Mobility Services

For private providers, the more profitable offering a mobility service is, the higher their willingness to develop more diverse offerings will be. Evaluation of customer data allows continual adaptation of mobility offerings to users' individual needs and preferences. This presumes that users have access to mobility services with the aid of digital technology, such as a smartphone. Platforms including Uber, DriveNow, and Car2Go are good examples of this, showing that innovative mobility offerings will in the future mainly be offered through digital interfaces. Nevertheless, the potential number of users and their purchasing power differ widely from region to region, and this will escalate the challenge of offering basic mobility services that have extensive coverage while still remaining affordable.

Economic considerations make it understandable that private mobility providers only offer their services in lucrative regions with many users and higher purchasing power. In more rural areas, this could lead to there being no or very few mobility offerings, or ones that are comparably expensive. For example, there aren't any car-sharing providers that offer their services beyond the major metropolitan areas at the moment. The same applies to the limited public transport offerings in rural regions. **A challenge along the path to preventing a digital divide in the area of mobility is that new mechanisms for offerings must adequately ensure that people living in peripheral areas are allowed to have the same mobility available in metropolises and that it remain affordable.**

*»Rural areas must hold their own against the city, which has become more attractive (due to solved traffic problems), through the creation of comparable offerings.«*



## ARE NEW TECHNICAL IDEAS REQUIRED TO OVERCOME THE DIGITAL DIVIDE? WHICH CAN YOU IMAGINE?

→ *The experts' view is that there will be innovative human/computer interfaces with intuitive gesture or voice control and new end-user devices (targeted to people with lower digital competencies) that will contribute to preventing a digital divide. In a fully automated future, visually impaired people, for example, must be able to order an autonomous vehicle. Experts agree that more than just technological concepts are required for overcoming the digital divide. Public discourse about blanket coverage and intergenerational inclusion is vital, as is promoting acceptance of new systems such as autonomous driving, and particularly advancing education and training to avoid the digital divide in the future.*

48  + ADDITIONAL QUESTION FOR THE EXPERTS



### Social Framework Conditions

Social and policy framework conditions play a crucial role for ensuring fair offerings and unrestricted access to mobility. A basic social understanding of new mobility services and supply services, and consensus about what minimum level of services should be provided and publically financed, is necessary. An effective framework and specific measures for providing comprehensively accessible mobility can be developed based on social consensus.

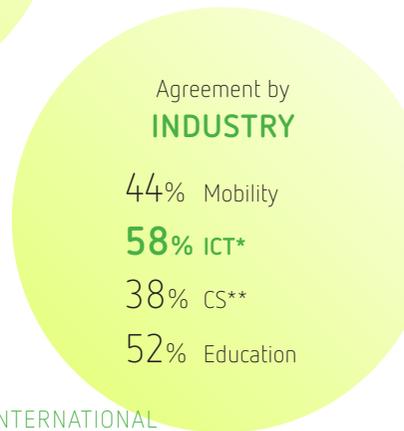
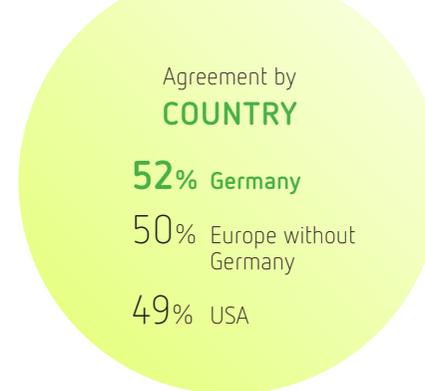
This calls for acceptance research at the start of this development and as an accompanying process so as to survey attitudes and changes in these attitudes. The development of intermodal mobility services based on the results should play a relevant role so that the expenses don't fall to just one operator, such as local public transportation companies. As of yet there are no binding standards for these types of joint cooperations.

Moreover, the parameters shouldn't be influenced by just the operators, but rather should incorporate the users and their changing needs. There is no doubt that access to mobility systems in the future will be digital. How a change in thinking will be brought about and how quickly it will come to the current 21% of the population who don't use the internet remains an open question, one that is crucial for the costs and quality of future mobility systems.

Expert Question (498 respondents):

# BLANKET COVERAGE FOR THE USE OF MOBILITY SERVICES WITHOUT THE USE OF DIGITAL ACCESS TECHNOLOGY MUST BE GUARANTEED IN THE FUTURE.

→ All questioned mobility experts (n = 498); the missing value to 100% = no answer; the proportion of agreement is represented as "Top 2" answers ("Agree completely", "Mostly agree")



51% OF THE INTERNATIONAL EXPERTS (N = 498) AGREE ("TOP 2")

30% ↑

17% ↑

0%

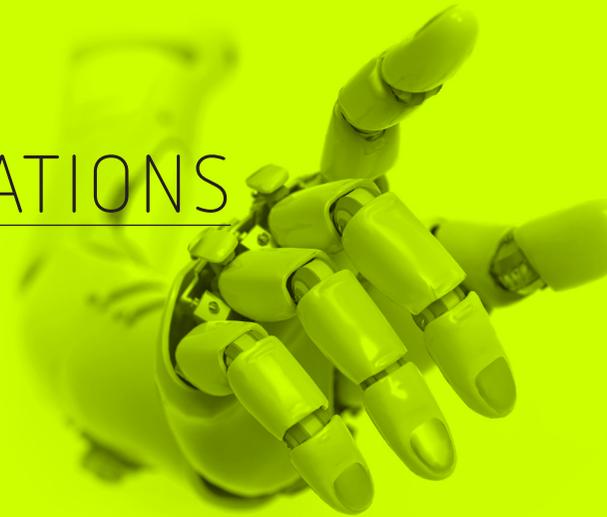
2 / 49

MOBILITY WITHOUT A DIGITAL DIVIDE

\* Information and communication technology  
\*\* Corporate services

# 2.2

## RECOMMENDATIONS FOR ACTION



### GUARANTEE A MINIMUM SUPPLY OF MOBILITY SERVICES AND ACCESS POSSIBILITIES (BASIC SERVICES)

Blanket coverage for basic mobility services in the future must be guaranteed with basic services by local public transport and with assistance from private mobility providers. Similarly to the telecommunications sector, mobility providers could be obligated to make basic mobility services available. The losses caused by providing such basic services could be offset by means of charges levied on other providers or through direct subsidies by public authorities. Unlike telecommunications, for mobility it is much more difficult to fulfil all the important requirements with one single service. This is where the social consensus becomes important; the services provided as part of a basic mobility service rest on this consensus, including doctor's visits, going to public agencies

and authorities, grocery shopping, and family visits. Mobility services that cover these basic services must be inexpensive or free so that everyone can afford them.

In the future, though, means of transport such as bus, subway, and train cannot be the only means for basic mobility services. Public authorities could operate a fleet of autonomous vehicles so that mobility can be made available in this way for people in underdeveloped regions and/or with little digital literacy. This basic mobility service, at least at the start, could not be solely operated by public providers; they usually don't have the expertise for new mobility services. The success of these measures will depend on to what extent private operators can be gained for these services or whether sharing-economy approaches will be effective. #



### CREATE ACCEPTANCE AND TRUST IN DIGITAL CHANNELS

Acceptance of digital mobility access can only be promoted if users understand that the digital provision of mobility services will bring them tangible benefits. Test locations could play an important role in this, offering a great deal of latitude for innovative services. Experiments could be conducted in these test locations and direct user feedback about the offerings could be gathered in order to generate flagship projects as quickly as possible. These flagships should be sought out by public authorities and industry. The more these high-profile flagships emerge, the more known and trusted these services will become. As a result, competition is purposefully encouraged.



Generally, accessing mobility should be as intuitive and simple as possible. An interesting approach could be the connection of a digital fingerprint with a bank account, so that passengers would be registered upon opening the door of an autonomous vehicle for a trip, and the billing would take place upon exiting the vehicle; digital skills or an additional device such as a smartphone wouldn't even be necessary. #

## ➔ DEFINE SOCIALLY ACCEPTABLE OBJECTIVES AND LIMITS TO INTELLIGENT MOBILITY OF THE FUTURE

To design mobility of the future according to our social values, such as those of individual freedom and equal rights for everyone, a discussion about universal inclusion for mobility must be started. This includes clarifying such issues as "Which basic mobility services must we guarantee?" and the financing of these basic services. This must be followed by designing mobility for users. The objectives and limits of future mobility must be developed under the auspices of politics and must span several different sectors. Considerations must also include goals, leverage, and possible incentives as well as sanctions for implementing "inclusive mobility fulfilment" and the related social values.

The framework conditions, which must be created politically, should lead to innovations in mobility being consistently oriented towards people, while considering the available infrastructure, and the finite resources of society. The aim should be to address customer needs, and develop a data culture with

enough platforms for testing new solutions, while meeting requirements of the various stakeholders. With these safeguards, products and services for the mobility of the future can be developed and promoted in a targeted manner. In this way, for instance, subsidising particularly environmentally friendly services could be required by the public authorities to increase overall social benefits. Certain user behaviours could be similarly rewarded, resulting in a credit for a personal mobility account that could be used for additional services.

The state will play an important financial role since many services and infrastructure components cannot be established or operated economically during the longer-term development phase. Various financing possibilities must be reviewed and offered. Along with traditional subsidies by the state, public/private partnerships may present an attractive and sensible means to systematically promote mobility services and quickly develop them to market maturity. #



REAL-TIME

# MOBILITY MARKETPLACE

Radical Change in Value Creation

TOPIC AREA

52

3





HOSTILE TAKEOVER – PEOPLE AND GOODS WILL  
BE TRAVELLING DIFFERENTLY IN THE FUTURE!

› THESIS



GLOBAL PLATFORMS WILL  
PRODUCE RADICAL CHANGES IN  
VALUE CREATION FOR MOBILITY.

› FINDING

MAINTAIN OPEN, FREE MARKETPLACES.

› RECOMMENDATION FOR ACTION





### Evaluation of the Future Concept

All of the technological foundations for implementing this future concept already exist. Generation Y has grown up with the sharing economy and won't have any problems accepting such a mobility system. Even a large proportion of people from older generations will be forgoing private car ownership for economic reasons. Moreover, the outlined mobility marketplace will solve numerous problems with respect to the selection, combination, and invoicing of mobility services. The security risks for package transport by private people are considered critical. For this reason, appropriate insurance policies (microinsurance) must be developed. What speaks against this future concept, along with the necessity for behavioural changes from users, is the potential inadequate scalability of the offered mobility solutions. There is a lack of incentive concepts that would motivate private people to deliver packets on their route, for instance from work to home. Another major challenge is being able to manage peaks in mobility demand to ensure the consistent availability of suitable mobility services.



### Feasibility of the Future Concept

Progress in advancing autonomous driving, in combination with the development of innovative concepts for autonomous modes of transport, are viewed as key prerequisites for making the outlined future concept a reality. A full-coverage 5G network is one of the central infrastructure components. According to experts, without reasonably priced broadband connections, neither the Smart City nor the Smart Home or Smart Car can be realised. The ability to offer an individual mobility mix without such networks and the analysis of the data created within them is considered impossible. Along with the

technical prerequisites for the successful implementation of this future concept, experts emphasise additional social and economic aspects; the mobility platform is supposed to solve society-wide problems and not just be operated under the aspect of profitability. For the platform to become established, the experts' opinion is that attractive mobility solutions should be offered that manage without sharing between modes of transport.



THERE ARE A MULTITUDE OF  
NEW MOBILITY SERVICES FOR  
PEOPLE AND GOODS, BUT USERS  
ARE OVERWHELMED BY THE  
COMPLEXITY OF SELECTION, PRICE  
COMPARISON, AND THE HANDLING  
OF THESE SERVICES.

# PROBLEM

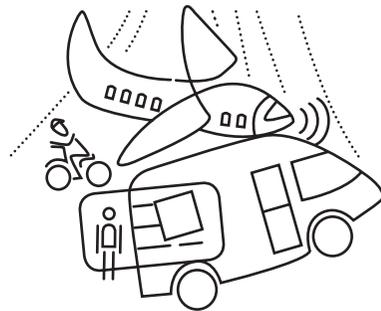
# 3

## REAL-TIME MOBILITY MARKETPLACE

Radical Change in Value Creation

*» Omnipresent, usable real-time information and standardised payment systems available through mobile end-user devices, such as smartphones, facilitate intermodal travelling «*

←  EXPERT



Until the new millennium, personal mobility was primarily associated with one's own vehicle or the use of trains and busses. Car sharing as an option instead of owning a vehicle wasn't widespread and didn't offer the flexibility of today's solutions. The networking of individual modes of transport was limited to the availability of schedules on the internet and the possibility of being able to book individual services through a stationary personal computer. Dramatic changes have occurred over the past seventeen years. Flexible car-sharing concepts without prescribed drop-off stations have made owning a car increasingly unnecessary in large cities, and all types of mobility services can easily be booked via a smartphone.

Because the mobility services offerings are continually growing, the market for users is increasingly confusing. Initial providers become established and no longer offer only their company's individual services, but integrated real-time solutions that cover the entire mobility chain, door to door. These

# 3.1

## CHALLENGES



### Finding the Right Operating Concept

A marketplace involves various providers offering their services or goods at a location in competition with one another. It is like an openly designed platform, where every provider has its own customer interface.

For a fee, the marketplace's provider supplies only the presentation area, whether physical or virtual. This concept does not control the offered services or pricing set by a platform provider. Applied to mobility services, this means that mobility services providers offer their services on an open mobility marketplace from which users can select the most appropriate combination of services and directly book them with the provider.

In contrast to the marketplace provider, a platform provider has no interest in the providers of services or goods coming into direct contact with the customers. The platform is what the customer sees; it presents the offer – in the case of a mobility platform, the offer of an integrated mobility chain.

The platform providers will control the flow of services, so mobility services providers must accept any resulting bottleneck. If they don't, the mobility platform provider can decide to forgo offering the services of this provider if there are alternatives.

types of platforms can suggest convenient train and bus connections, allow online booking, reserve parking spaces or car-sharing vehicles, and order taxis. A connection to goods transport, for instance in the boot of car-sharing vehicles, is possible if the security issues can be addressed.

If users come to accept these new mobility platforms as intermediaries to integrated mobility offerings, the original providers of the individual services will lose contact with the end customers. They will form the second tier of the mobility fulfilment system because the platform providers will be the interface to the customers. This creates new interdependencies because the mobility service provider will become a subcontractor to the platform provider. This permits the platform provider to influence the pricing structure of "its" service providers and give preference to specific service providers. For users, the mobility fulfilment system becomes less transparent and the possibility for comparing prices ceases to exist.

This power structure probably explains why there are numerous providers of mobility services, but only a few integrated mobility platforms. Particularly in places where mobility services providers compete with one another, they do not want to jeopardise potential competitive advantages by offering their services anonymously through a mobility platform. Mobility platforms that want to become established on markets should take this into account and give the mobility services providers the possibility to present themselves to end customers through the platform so that customers can put together a portfolio from their preferred providers.

**Whether it's a platform or marketplace, considerable start-up investment is required, including supplying the service space and developing the software necessary to run it. Operations and maintenance are cost intensive.** Potential investors must be convinced of the profitability of such investments. To date, investors have been more cautious and are more likely to invest in individual mobility services providers instead of in mobility platforms, as the share prices of numerous mobility services providers impressively demonstrate.

Mobility marketplaces could be an attractive alternative because they allow users more discretion for decision-making and the intermediaries between service provider and customer disappear. This makes operating a marketplace cheaper and thus more profitable as compared to a platform. Current providers of online marketplaces could expand their offerings, but new marketplaces focussed solely on mobility services could emerge. If the necessary customer base exists and enough mobility services providers offer their services, such marketplaces could conceivably develop into a platform, initially in the form of an option, and later, when there is enough demand for platform services, a complete changeover can be envisioned. One factor that is currently impossible to predict is to what extent restrictions on private transport in cities, as can be seen in some metropolises, will foster this development.



## Preventing Monopolies

A strong trend can be seen leading to hidden or open monopolisation in the internet economy. This is promoted to a certain extent by the users, who want platforms that are easy to use and offer consistency, and prefer these to other offerings. Well-established brand names are also important for survival in the internet economy, as eBay and Facebook demonstrate.

Similar trends can also be expected for mobility platforms if they become established on the market. Why should users seek out alternatives when there is a platform that works reliably and offers all the important services at a good quality?

The first provider who succeeds in establishing such a mobility platform will have the pole position. If that provider also manages to offer comprehensive coverage with sufficient alternatives, competitors will have a difficult time positioning their services.

However it has also been seen that the "top dog" in the internet economy can quickly disappear if mistakes are made that have an impact on user acceptance or even if a service is suddenly considered "uncool". Notably, the example of internet search engines demonstrates that others can quickly move up and take over the position of top dog until this cycle repeats itself anew.

The basic requirement for the success of an interface is that users commit to the mobility platform. Only then will enough mobility services providers be willing to market their services through the platform, which in turn is the foundation for user acceptance and the platform's success.



» *Competition for the best business model for mobility services providers is already well underway.* «



This interdependent cycle means that established platforms can block newcomers to the business. Without a sufficient number of users, the providers will fail to appear, and without a sufficient variety of providers and coverage, the users will also fail to materialise. This could quickly result in the formation of a monopoly or an oligopoly at a minimum. **Newcomers must offer a unique selling proposal that makes their platform attractive for users despite the smaller offering of mobility services, or make it attractive for mobility services providers despite the comparatively lower numbers of users.**

A platform is attractive for users by way of its visual appearance, ease of use, and consistency across the variety of mobile devices from which the platform can be accessed. The costs of use also play a role. A premium product might allow higher prices to be charged. At the other end of the range, a platform financed through advertising could be attractive for users when they can use the platform free of charge.

To be attractive for mobility services providers, new mobility platform providers could select strategies similar to those they use to acquire users. Listing mobility services without commission fees for the mobility services providers is conceivable, at least for a limited time. Likewise, a platform provider could position itself as a premium services provider for more affluent customers to offer the listed mobility services providers higher margins than other platforms do.



### High-Quality, Real-Time Data for Everyone

Internet users are accustomed to receiving information virtually in real time. Often users of internet search engines either ignore or accept as a given that this information must be examined for relevance and that the information they are actually searching for must first be filtered out.

This isn't acceptable for real-time mobility services providers. Users expect information customised to their momentary needs, allowing them to quickly, easily, and cost-effectively reach their destination with as few changes in modes of transport as possible. Alternatives should be provided, where applicable. The current traffic situation or delays with local public transport must be taken into account for the initial configuration of the offering, and, ideally, a real-time mobility platform will also use rescheduling to get customers to their destinations as close to the desired time as possible. A mobility marketplace must propose the necessary transfers and/or booking changes to users in this case.

The data necessary for this is generally available; however the quality and timeliness isn't always sufficient to meet customers' demands. Furthermore, this information is not centrally available – it is either scattered among the various transportation providers or comes from external sources – meaning it isn't readily available for a mobility service.

## WILL THERE BE PROVIDERS THAT OFFER **TRANSPORTATION SERVICES FOR FREE** BECAUSE OF REVENUES FROM OTHER SOURCES/SERVICES LINKED TO THESE SERVICES? IF YES, HOW WILL THEY ACCOMPLISH THIS?

→ *As in the software industry, with established freemium pricing strategy models, mobility providers could offer just passenger transport free of charge, with upgraded and/or additional services for a fee. Simple mobility services could be financed through advertising. These approaches seem plausible in view of the advances in autonomous driving. If travellers no longer have to focus on driving a vehicle, a lot of time remains for consuming media and advertising. Consequently, one expert suggests cooperation between mobility services providers and consumer and consumable goods manufacturers. Another expert, however, expresses doubts about whether cross-financing of the investment and operating costs through the sales of additional services is realistic for transport operators.*

➤ ADDITIONAL QUESTION FOR THE EXPERTS

It is in the interest of the mobility services provider, the mobility platform, and/or the mobility marketplace to make the required data available in the best-possible quality. However this encounters a series of problems. The secure, fast data transfer between users and platform is the first problem and is particularly relevant when discussing payments or the transfer of information in real time. LTE has not fulfilled expectations in Germany, particularly as regards availability and coverage. LTE still doesn't have blanket coverage, particularly in rural areas, and the necessary data transmission quality isn't assured in cars, busses, or trains (since it also depends on the travelling speed). As a result, information about scheduling changes or rebookings can reach users too late, even if it is supplied by the mobility services provider in a timely manner. To what extent 5G will fulfil all the demands for real-time mobility platforms as regards availability, security, and latency remains unclear; the development of 5G networks must be worthwhile for operators if not receiving government support, something providers of mobility platforms or marketplaces will have to take into account when setting up their services.

The data format being used is just as important as dependable data transmission and data processing. Ideally, standardised formats would be used, even just one format from the point of view of the mobility platform provider. However it must be assumed that a majority of mobility services providers will use proprietary data formats that are incompatible, not only between the individual transport carriers but between the individual mobility services providers. For use through a mobility platform or a mobility marketplace, these data formats must first be "translated", but where this "translation" will occur remains unclear. A platform or marketplace provider will view this as a responsibility of the mobility services providers, while these providers will certainly not wish to present their data in different formats to every mobility platform

Expert Question (498 respondents):

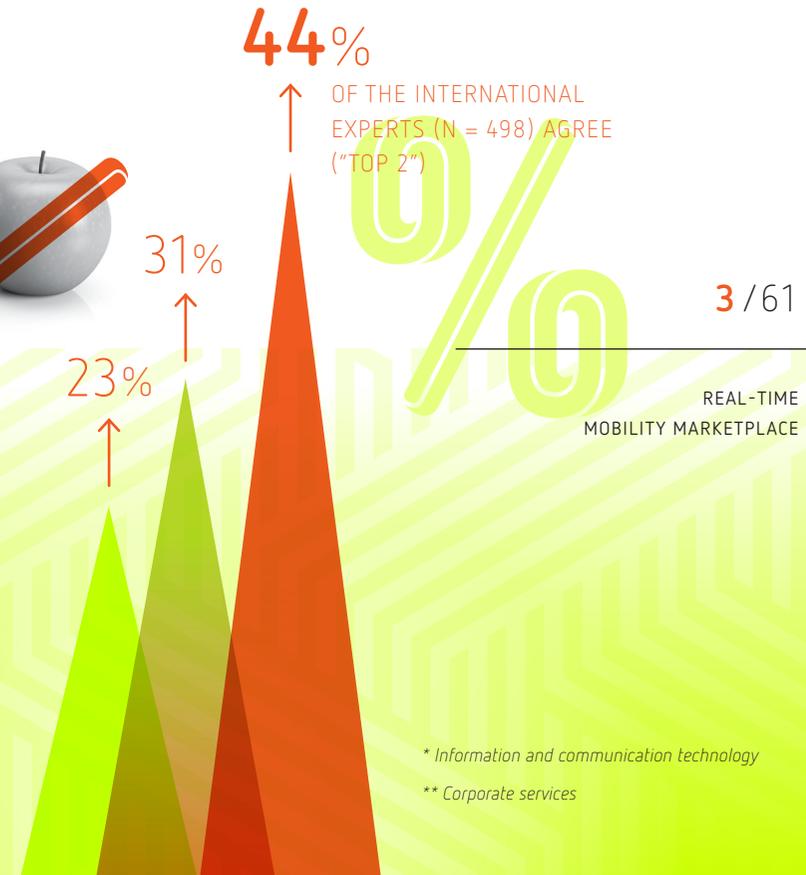
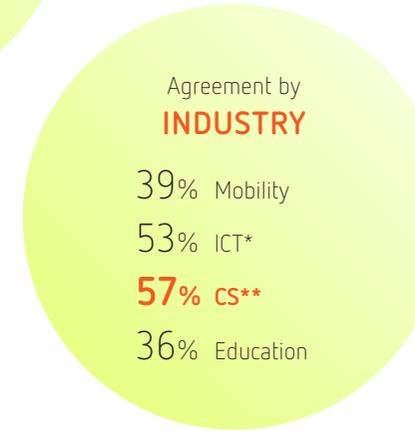
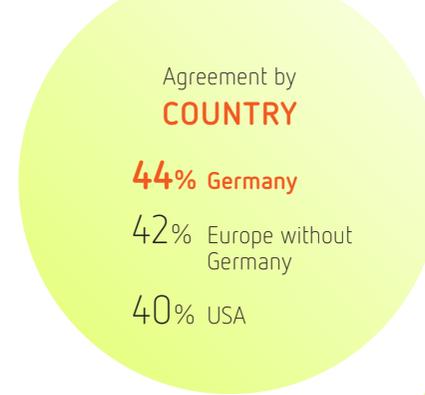
# TECHNOLOGY CORPORATIONS NEW TO THE MOBILITY SERVICES INDUSTRY WILL SUPPLANT LONG-ESTABLISHED MOBILITY PROVIDERS.

→ All questioned mobility experts (n = 498); the missing value to 100% = no answer; the proportion of agreement is represented as "Top 2" answers ("Agree completely", "Mostly agree")



marketing their services. Service providers and mobility platform/marketplace providers will have to negotiate amongst themselves, and the "market power" of both sides will play a crucial role here.

An efficient, real-time mobility platform will distinguish itself by being able to best solve the above-mentioned problems. The answer to this question will ultimately decide which platforms eventually prevail.



\* Information and communication technology  
\*\* Corporate services

# 3.2

## RECOMMENDATIONS FOR ACTION



### → MOBILITY MARKETPLACES AS A FIRST STEP TOWARDS PLATFORMS

The number of mobility services providers has greatly increased, and customers, especially in metropolises, can select from numerous alternatives. Yet so far few mobility platforms have been able to establish a presence on the market. Mobility marketplaces as described above aren't known at all as of yet. Some of the reasons for this are that such platforms or marketplaces only become attractive to customers when they have enough offerings to provide to users in an easily understandable and easy-to-use form; that the offerings of the majority of mobility services providers have enough demand – even without a connection to a mobility platform – and; from the point of view of the provider, that there is no reason for the service providers to market their services through a mobility platform, which would create additional costs for them and would prevent direct contact with customers.

Mobility marketplaces where customers put together the most appropriate mobility solution from an array of offerings could be an alternative. Investors might prefer setting up mobility marketplaces because they are cheaper than integrated mobility platforms. #



### PROVIDER VARIETY AS KEY TO SUCCESS

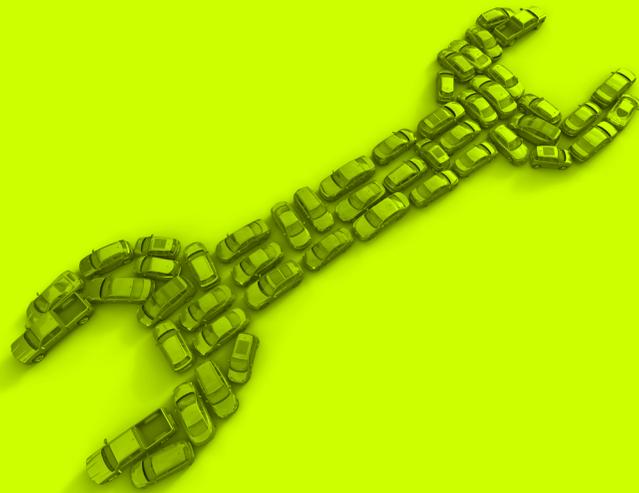
A mobility marketplace can only be successful when enough mobility services providers offer their services on the marketplace and when enough people use the marketplace to order these services. Attractive pricing schemes for providers and customers could help promote such marketplaces. This is even more the case for mobility platforms because the efforts required by the platform to offer its services are considerably greater than they would be for a marketplace.

What will be crucial for the emergence of both platform and marketplace solutions is whether the number of mobility services providers will grow to such an extent that potential users require "tools" in order to be able to make the best selection for themselves, or whether there will be a consolidation where only a few providers survive. In this case, providers of integrated solutions – no matter whether on a marketplace or platform – will have problems getting established on the market.

The risk with the introduction of mobility platforms or marketplaces is thus great, which is why start-ups will most likely have a difficult time successfully placing such services on the market. Along with the initial investment in developing the service, a certain financial perseverance is required before operations become profitable. It might make sense to offer such platforms or marketplaces in cooperation with existing online services. Online auction platforms or online department stores, and operators of internet search engines, too, are possibilities here. These could naturally expand their offerings to include mobility services. #

## → EASE OF USE AND INTEGRATION INTO SOCIAL NETWORKS FOR INCREASING ATTRACTIVENESS

Internet-based services and apps are only appealing to users when they are easy to use and present the desired information in an understandable way. This is one of the keys to acceptance for mobility platforms and marketplaces, and the providers of such services are well advised to place great value on user-friendliness when designing the interface. The possibility for personalisation, integration of social networks, and for making contact with other platform users, for instance to communicate arrival times or to arrange ride sharing, could be further keys to success. #



## → FAST NETWORKS AS ENABLER

Another prerequisite for the broad acceptance and use of such platforms or marketplaces is comprehensive availability of suitable mobile communication networks and fast internet connections. There still remains considerable need for action in rural areas in Germany, but this is up to the platform and marketplace operators. Telecommunications companies and the government have important roles to play; the former must ensure coverage in previously neglected, less densely populated areas, and the government must create the incentives necessary to achieve this. #



## → NO SUCCESS WITHOUT ADVERTISING

Last but not least, a new mobility platform must be adequately advertised to achieve the required prominence. Advertising on all of the modes of transport offered on the platform is conceivable, as well as through the usual channels on the internet. Advertising in print media and on billboards could make sense, at least during the introductory phase. This is crucial for success and requires considerable financial resources, which must be raised by the provider. It will be interesting to see whether additional mobility platforms or mobility marketplaces will gain a market presence in the next ten years alongside currently existing platforms. A key factor in this will be how strong the growth is in the mobility services offerings, and whether users require internet-based services to be able to efficiently use them. This currently appears not to be the case, at least in Germany and Europe. However, further urbanisation and pollution-related driving restrictions in larger cities could lead to the emergence of new mobility services providers, which could subsequently lead to platforms and marketplace services finding a profitable foundation as mobility services brokers. #

# POLITICAL CHANGE IN THE UNDERSTANDING OF INFRASTRUCTURE

TOPIC AREA

64

4





YESTERDAY'S UNDERSTANDING OF INFRASTRUCTURE  
BLOCKS THE INFRASTRUCTURE POLICIES OF TOMORROW

› THESIS

INFRASTRUCTURE POLICIES LACK  
AN INTEGRATED APPROACH.

› FINDING

THERE IS AN URGENT NEED FOR DOMAIN-  
SPANNING EXPERTISE AND FASTER  
INFRASTRUCTURE POLICY DECISIONS.

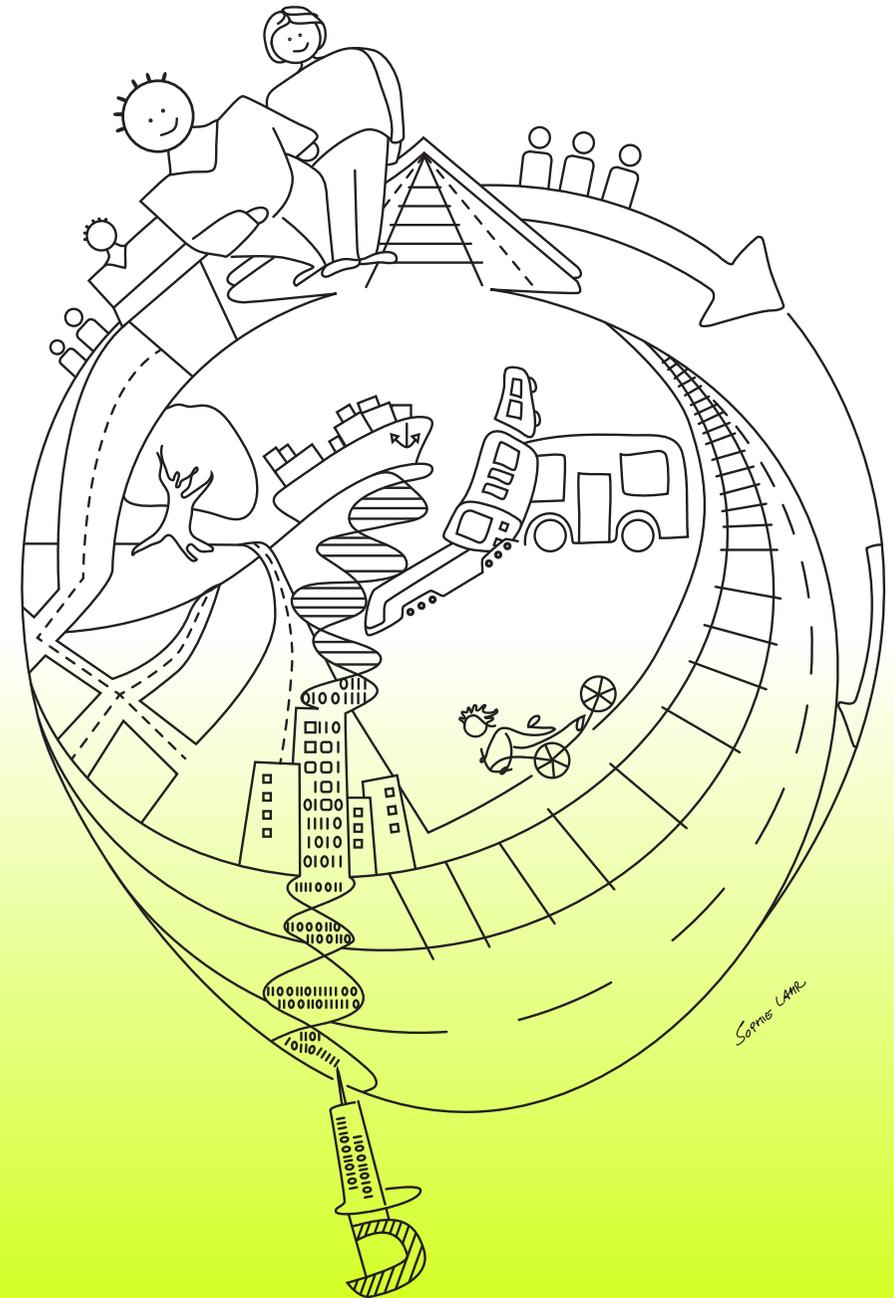
› RECOMMENDATION FOR ACTION



# FUTURE CONCEPT

Political and business decision-makers take a more integrated view of infrastructure, based on ICT infrastructures. Physically speaking, the existing infrastructure (roads, rails) are viewed as regards their further development and modernisation needs, for instance expanding local public transportation in cities.

This will include future, unknown infrastructures, the specific final forms of which aren't yet clear, including e-mobility and sharing infrastructures as examples. The planning horizon is problem-oriented, allows both short-term and long-term decision-making, and includes nascent interdependencies with other IT-controlled infrastructures (i.e., energy, health, education), which are already becoming apparent or are expected to be so in the future. To enable fast, responsive planning and the necessary evaluation and decision-making processes, the legal framework has been expanded in such a way that short-term adaptations are possible. Flexibly adaptable regulations have replaced detailed regulations and definitions. Conventional financing models have been further developed to allow more flexible variations. Citizens, as users of such systems, also play a more decisive role. Transparency and the early involvement of citizens in these processes lead to the acceleration of evaluation processes and more consistent implementation and acceptance of infrastructure measures. Transparency also leads to an increased acceptance of the possibilities for participation and thus the ramifications of the various measures.





THE PREVAILING UNDERSTANDING OF INFRASTRUCTURE IS TOO RIGID, TOO STRONGLY GEARED TO INDIVIDUAL AREAS (RAIL, ROADS, PUBLIC TRANSPORT, ENERGY ...) AND TOO DOMINATED BY SPECIAL INTERESTS.  
AS A RESULT, IMPLEMENTATION OF INFRASTRUCTURE-RELATED MEASURES TAKES TOO LONG.

# PROBLEM



### Evaluation of the Future Concept

The experts expressed no clear-cut opinion about this future concept, although the outlined idea was viewed as desirable. However, inertia in political structures and processes was viewed by several experts as too great for the concept to be a realistic solution. They noted that the urgent, long-needed reduction in bureaucracy to shorten decision-making processes is something that has yet to occur. In Germany, the sluggish introduction of smart meters and missed targets for establishing electromobility are emblematic of the problems with infrastructure policies. Even in the future, infrastructure policies will continue to lag far behind actual changes in needs and requirements. Significant changes to planning law are needed as it directly applies to infrastructure and to Germany's federal structures. Apart from the political obstacles, doubts were voiced about the manageability of a single, convergent infrastructure due to its complexity.

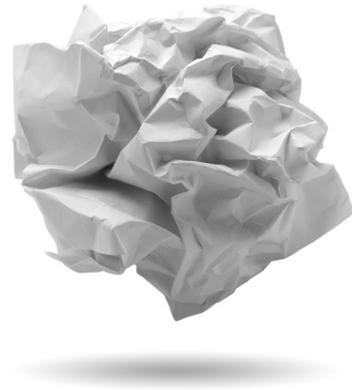


### Feasibility of the Future Concept

The experts see a need for action from politicians, not just in infrastructure planning but in infrastructure financing. Potential proposals include the creation of participation and investment models that offer investment and cooperation incentives to the providers of traditional infrastructure, not just ICT businesses. However lawmakers are blocking development of innovative mobility concepts based on convergent infrastructure; they tend to protect existing business models rather than promoting the development of new ones.

# 4

## Political Change in the UNDERSTANDING OF INFRASTRUCTURE



*»... any new infrastructure planning is talked to death in the political discourse.«*

▲  EXPERT



Supply infrastructure was and remains an elementary foundation for social and economic life. It creates encouraging or limiting conditions for transforming economic concepts, social models, and even the most fundamental needs of daily life. This foundational quality makes its development and expansion, maintenance, and operation a central policy objective. Infrastructure is generally understood to mean all public and private facilities that are considered essential for adequate public services and economic development. Infrastructure is also often divided into technical infrastructure (i.e., facilities for transport and communications, energy and water supply, waste disposal) and social infrastructure (i.e., schools, hospitals, sports and leisure-time facilities, shopping areas, cultural institutions). As regards mobility fulfilment systems (MFS, see the chapter “Mobility Fulfilment System 2025+”), the primary concern is technical infrastructure.

Further accelerated changes to requirements, technical developments, and the planning and financing conditions create increasingly complex system interdependencies. Since these MFS infrastructures supply basic public services and foster economic development in the broadest sense, their fundamental political relevance is evident. Moreover, their importance increases in the context of digitisation – firstly, because there is a considerable need for restructuring, reorganisation, and upgrading, and secondly, because new solutions, new benefits, and thus new economic potential based on changing infrastructure all emerge through digitisation.

**When considering the changing demands for mobility-specific infrastructure, it becomes very clear that an infrastructure revolution is required if we want to pave the way for electromobility and autonomous driving.** Successful integration of electromobility and autonomous driving in transport concepts, as well as the intermodal networking of modes of transport, including local public transport, necessitate the strong interlinking of various infrastructure components (electricity, telecommunications, transport routes). Without the much-discussed comprehensive charging infrastructure for electric cars, their potential remains unexploited. Without highly available, mobile broadband telecommunications infrastructure, autonomous driving and the associated access and invoicing concepts won't gain acceptance. There are no established methodologies or policies for these cross-infrastructure points of view and contexts, the necessary identification and design of new technical infrastructures, nor the convergence of infrastructures required for integrating, expanding and developing them. Infrastructure policies remain stuck in the narrow ruts they have traditionally occupied. Yet the current dynamic transformation of the demands on infrastructure calls for a new type of planning.

The ability to anticipate this transformational momentum is a critical success factor for future mobility solutions and is therefore a special challenge for politicians. This becomes particularly clear with the striking problems for MFS infrastructures listed below.

*»Planning, decision-making, and comprehensive realisation (of infrastructure measures) often takes many years. Initiatives for reducing bureaucracy haven't yet achieved any significant effects.«*

←  \* EXPERT



# 4.1

## CHALLENGES



### Reconfigure political and professional planning autonomy of the nation, cities, and municipalities?

There is an extraordinarily complex planning, requisition, design, budgeting, and realisation process underlying current transportation infrastructure policies. It is very difficult for the federal government, cities, and municipalities in Germany to reach an understanding about mutual planning and implementation goals. The increasing complexity due to exacerbated conditions (noise, particulate matter, decarbonisation), recognising and designing new, necessary infrastructures (mobile communications, GPS/IoT), and the reciprocal dependencies between infrastructures (rail/roads, transport/mobile communications, internet/GPS/IoT) transcend traditional planning processes. Departmental demarcations, path dependencies, and inertia block transformation and a comprehensive understanding of the system. The challenges of the digital transformation, with new technical developments, the necessary convergence of infrastructures, new operational and business forms, or even disruptive developments, cannot find their way quickly into mobility planning or implementation (e.g., the lack of future options in the current 2016 Federal Transport Plan beyond conservation measures and removing bottlenecks). Additional complicating factors include quickly changing economic concepts for financing and operations, and the changing balance between federal, state, and municipal responsibilities in Germany.



### Involving citizens in planning processes, especially by using new methods

MFS infrastructures, their problems, planning, and implementation are being exposed to ever-increasing public awareness and influence. Major projects such as airports, train stations, autobahns, and urban planning show citizens' demands for participation in planning goals, benefit arguments, implementation problems, and cost controls. While veto rights can lead to unpredictable delays in planning and realisation processes, decision-making in the public sphere is increasingly a significant part of infrastructure planning. Present understanding of experiences and growing knowledge of citizen participation processes<sup>2</sup> must urgently be complemented with information about dealing with new media for information sharing and addressing stakeholders. Early inclusion of all stakeholders is critical for success. Participative processes started between politicians, businesses, and society early in the process can help promote public opinion-making and prevent the necessity of spectacular mediation processes for consensus building after escalation by representatives of stakeholder interests.

<sup>2</sup> Patrizia Nanz, Miriam Fritzsche; *Handbuch Bürgerbeteiligung (handbook for citizen participation, in German)*; Bundeszentrale für politische Bildung; Bonn, 2012; ISBN 978-3-8389-0200-5



## Proactive initiation of technical and economical approaches to mobility solutions

Initiating and creating conducive conditions for new mobility solutions will play a key role for future (MFS) infrastructure policies. Essential parts of future-oriented infrastructure policies include the early identification, system-wide consideration, and technology and application research based on future parameters, hypotheses, and application conditions, and exemplary application development. Democratically legitimised cooperation between state and industry is also important. Current examples on the path to 2025+ excellently illustrate initial problems and new responsibilities for infrastructure policies' developmental function:

### 1. **Develop technologies for mobility solutions and connect these with developing infrastructure measures in a timely manner.**

One example of this is the Electromobility government programme and the founding of the "National Electromobility Platform", which forges a connection between vehicle technologies and the accompanying infrastructure technologies (electricity) to achieve technology and operational leadership.

2. Funding programmes for autonomous and networked driving have set a special focus on the development and dependable delivery of new technical infrastructures to accompany this, including satellite navigation, 5G mobile communications, and IoT (Internet of Things). **These new technical infrastructures are essential for the "mobile future", but each is also an essential infrastructure for other areas of society and the economy.** This demonstrates the necessity of new, needs-focused, comprehensive infrastructure policies that consolidate the requirements and design profiles between the application areas. For mobility, this includes infrastructures such as hydrogen and inductive charging, and for those with comprehensive functionality includes 5G, IoT, and new invoicing concepts.

*»The agile structures for comprehensive expert planning in the future are faced with incrustated, lengthy decision-making processes that will remain very cumbersome moving forward, the inertial tendencies of which limit necessary changes to a minimum.«*

▲  EXPERT



## TO WHAT EXTENT CAN A SHIFT IN ACCEPTANCE OF VARIOUS MOBILITY INFRASTRUCTURES (RAIL, CAR, PUBLIC TRANSPORT, INDIVIDUAL TRANSPORT, SHARING, ETC.) WITHIN THE GENERAL PUBLIC BE EXPECTED?

→ *The acceptance of sharing models will grow at the expense of individual vehicle traffic. As soon as new concepts are beneficial, they will be accepted by the populace. This shift can already be observed today, though it is strongly dependent upon age group. Younger, more urban people in particular increasingly use sharing models. If the environmental impact of increasing traffic continues to rise, and health risks increase, acceptance of new mobility solutions among the populace will increase.*

➕ ADDITIONAL QUESTION FOR THE EXPERTS

3. **Creation of model regions for digitisation where application-oriented technology development and mobility and management infrastructures lead to new convergent benefits, e.g., the Main-Rhine-Neckar model region and the Digital Hub Mobility in Munich as testing grounds.** The change in political significance of these technology and infrastructure policies achieves significance both through initiation and financing, and, more importantly, through integration and implementation of infrastructure planning that is forward looking, open to change, and comprehensive.
4. Along with the new transport modes concepts, it is fundamentally important to focus on transforming and adapting today's inventory of existing infrastructure. **This may not be limited to just electrifying railway lines. Instead of linear accrual work, the focus for this inventory must be placed on integrating overall system considerations and accelerating adaptation, planning, and implementation processes.**



Expert Question (498 respondents):

# TODAY'S **INFRASTRUCTURE** POLICIES, WITH THEIR DECENTRALISED PLANNING PROCESSES, **BLOCK** THE SUCCESSFUL DEVELOPMENT OF **FUTURE-ORIENTED,** **NETWORKED MOBILITY CONCEPTS.**

→ All questioned mobility experts (n = 498); the missing value to 100% = no answer;  
the proportion of agreement is represented as "Top 2" answers ("Agree completely",  
"Mostly agree")



## ⇒ Fulfilling changing social demands within the interplay of state and society

Future social changes mean MFS infrastructures will face new challenges as described in the future scenarios, including a focus on metropolitan areas and Smart Cities; changing environmental consciousness; increasing health demands (noise, particulate matter) or the decarbonisation movement; the digital transformation of business and society; and an ageing society. Transformed, forward-thinking infrastructure policies must integrate these socially relevant influences. Soon we must expect traffic restrictions, if not outright bans, for cars in cities. New mobility offerings will compete for traffic areas that cannot be increased – coordinated roles aren't defined. The limited traffic area fuels competition for its exploitation. MFS infrastructure policies must take up forward-looking positions in these areas.

64%  
OF THE INTERNATIONAL  
EXPERTS (N = 498) AGREE  
("TOP 2")

Agreement by  
**COUNTRY**

64% Germany

64% Europe without  
Germany

60% USA

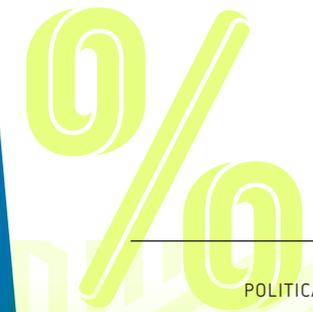
Agreement by  
**INDUSTRY**

66% Mobility

69% ICT\*

64% CS\*\*

55% Education



4 / 73

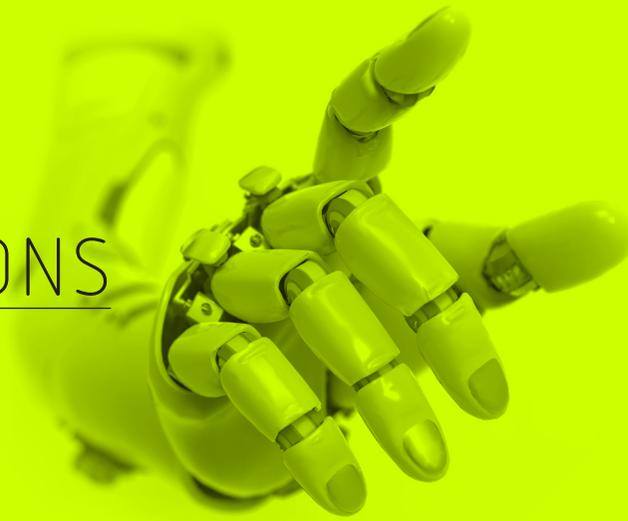
POLITICAL CHANGE IN THE  
UNDERSTANDING OF INFRASTRUCTURE

17% 18%

\* Information and communication technology  
\*\* Corporate services

# 4.2

## RECOMMENDATIONS FOR ACTION



⇒ THE DIGITAL TRANSFORMATION IS THE KEY CHALLENGE FOR THE FUTURE OF INFRASTRUCTURES IN ALL AREAS, PARTICULARLY ON THE PATHWAY TO MOBILITY 2025+.

The political challenge for designing future mobility lies in accelerating development and expansion of new technical infrastructures, in changing the framework conditions (society, law), and reorganising and restructuring planning assumptions while taking into account disruptive developments in technology, the economy, and society. These include measures that support the deployment of new technical infrastructures (5G, IoT), horizontal and vertical convergence, data integrity, expediting digital applications (user interfaces, platforms), and creating and coordinating new mobility service concepts, notably in limited traffic areas.

1. Digitising existing MFS infrastructures and accelerating new digital infrastructures are crucial enablers for mobility's evolution. Speeding up development of policies that will pave the way for them is of fundamental importance. #
2. Future MFS infrastructures are completely networked. This requires cross-system considerations and planning. The complex system interdependencies and accelerated development promote new, interdepartmental expert skills and structures to unite infrastructure, mobile transport modes, and communication into a future-oriented mobility fulfilment system. #
3. Communication infrastructure requires new, comprehensive coordination to meet the variety of demands from a future mobility fulfilment system for transmission mediums, coverage, broadband, and access rights. #
4. The transport area is a non-expandable resource. A variety of new mobility solutions from private and public providers crowd the future mobility market. The development of efficient and productive mobility fulfilment systems for city and metropolitan regions necessitates new responsibilities for coordinating between public and private mobility offerings to effectively make the fast changes and new offerings usable for citizens. #

*» We need a convergent and integrated infrastructure. [...] This converged infrastructure is probably the most complex IT system that we've ever pursued. «*

←  EXPERT

# CHALLENGES FOR MOBILITY SYSTEMS IN CHANGE

Owning / Sharing, Self- / Autonomous Driving, Public / Private

► TOPIC AREA





NO MORE INSULAR THINKING!

› THESIS

THINKING IN EITHER/OR  
CATEGORIES RESTRICTS  
MOBILITY

› FINDING

UTILIZING THE POTENTIAL OF FLEXIBLY  
CONNECTING ALL MOBILITY OPTIONS.

› RECOMMENDATION FOR ACTION



# FUTURE CONCEPT

The control of mobility supply and demand occurs through several online service platforms. This is based on the collection of data necessary to ensure the optimal transport of the person.

This can include personal data, such as preferred modes of transport, addresses, interests, etc., and other real-time data about current traffic volumes. Based on this data, online service platforms provide individually customised solutions. This process further tries to achieve an overall global optimum for mobility planning with which the journey time for everyone is reduced to a minimum. Individually customised solutions network several modes of transport (trucks, bikes, scooters, trains, public transport) and combine different sharing systems, especially in the C2C area. Offerings in cities include a combination of public transport, sharing systems and autonomous robot taxis; the in rural areas, "sharing vehicles" that can autonomously drive back to their starting points (i.e., public transportation) are in use. The entire transaction process, from booking to invoicing, occurs within an integrated system, free from discrimination and according to the best-price principle. Thus acceptance of these online service platforms is very high. Restrictive political regulations for use of individual vehicles promote the use of these new systems, resulting



in declining private car ownership; private transport is becoming increasingly luxurious, something that not everyone can afford or is willing to fork out. Meanwhile, sharing modes of transportation and transport in general experience similarly high levels of acceptance as sharing housing/flats in the past, and is used as part of everyday life.



# INDIVIDUAL TRAFFIC VOLUMES AND THE EXISTING, NON- EXPANDABLE TRANSPORTATION INFRASTRUCTURES ARE REACHING THEIR PHYSICAL LIMITATIONS.

# PROBLEM



## ➡ Evaluation of the Future Concept

The majority of the experts are persuaded by this future concept. In their view, the concept corresponds to younger people's mobility requirements and their general lifestyle habits. But other age groups will also be searching for alternatives to driving their own cars, with a view to rising costs of living and traffic situations in urban areas. With mobile applications that offer intermodal route suggestions, including billing and e-ticketing, access to these types of alternatives are already close at hand today for almost everyone. Due to lower population densities in rural areas as compared to cities, the experts question whether the presented mobility offerings will be economically efficient. Furthermore, the future concept requires considerable behaviour changes for many users, which one expert believes will take much longer than is assumed in the concept.

## ➡ Feasibility of the Future Concept

Along with the technological requirements, the experts see changes as necessary in two areas: regulation and cross-provider cooperation. Adapting the regulations, for instance in the form of repealing the German Public Transportation Act or introducing comprehensive parking-space management, could create incentives to promote competition. To support alternative engines and mobility concepts, registration for vehicles with traditional combustion engines could be subject to tighter restrictions. Various mobility

providers must be willing to join together on common platforms so that individual mobility solutions can be combined into integrated mobility offerings. Any such platform must be open so that it doesn't lead to monopolies in the field. At the same time, international, cross-provider invoicing and payment methods must be developed and introduced.

# 5

## CHALLENGES FOR MOBILITY SYSTEMS IN CHANGE

Owning/Sharing, Self-/Autonomous Driving, Public/Private

*»(In the future) the focus should be on combining all mobility services providers, especially with public transport.«*

← EXPERT



⇒ “Mobility-on-demand” thinking is becoming increasingly prevalent. Consequently, customers want to specify the means of travel, and its comfort level, to suit their particular needs in each instance. The spectrum of possibilities for getting from point A to point B is increasingly diverse and wide-ranging. These possibilities are based on new, to some extent disparate, and even controversial mobility and behaviour concepts:

- Possession/ownership of means of transport (e.g., car, bicycle, scooter, bike, etc.) vs. sharing of the same
- Self-driving, autonomous modes of transport vs. individually driven vehicles
- The use of public (local public transport) vs. private mobility offerings

Technologically or socially driven developments will expand the spectrum of mobility services and the underlying behaviour concepts. For instance, there are mounting discussions about the use of airborne modes of transport (e.g., drones or aerial cableways in cities) versus ground-based transport. Independent from these or other generally conceivable developments in the area of mobility, it becomes clear that a multitude of mobility solutions exist or are nascent, allowing a variety of combinations to solve individual mobility issues.

However, these varieties of different models stand more or less separate from one another, and there isn't any overarching coordination or integration of the various concepts. Because of this, and for historical reasons, this suggests to users that they must settle on just one concept or the other. Consequently, a sort of insular thinking has developed – both by the users as well as by the providers and/or organisers. Following this insular thinking, mobility concepts that perhaps aren't as fully developed may experience less acceptance. This applies to the idea of sharing, in which many aspects remain unsettled or uncertain, and it has not yet emerged whether sharing is a short-term fashion or whether it will develop into a viable concept for the future. This also applies to the idea of autonomous driving; discussions about it explicitly or implicitly assume that autonomous driving is immediately realisable in every traffic environment. If it is instead assumed that autonomous driving will be implemented at different speeds and with varying success depending on the traffic environment, intermediate forms on the pathway to complete autonomous driving can be recognised that are compatible with other mobility concepts. Examples include robot taxis or other autonomous transport systems that drive safely in specific traffic environments.

The growing variety of offerings and combination possibilities for mobility concepts – based on the corresponding organisational and technical infrastructure – don't just represent efficient solutions for the increasing mobility-on-demand thinking from users; it also allows a new type of mobility that

moves beyond traditional insular thinking and promotes integrated mobility solutions. In this integrated mobility system, the existing individual solutions can be efficiently combined through the use of digital technologies and platforms in particular so that behaviour and context-dependent, integrated, and comprehensive mobility solutions emerge. Subsequently, it's no longer about a person deciding for one OR the other mobility concept. Instead it makes it

*»The USER expects nearly unrestricted mobility around the clock as an attractive offering.«*

▲ EXPERT

possible to use one AND the other mobility concept. How exactly the use will be represented ultimately depends on the basic question: When does it make sense to use which form?



# 5.1

## CHALLENGES

➡ For this type of linked mobility system to actually be realised, a rethinking of things is necessary – away from insular mobility categories and either/or way of thinking towards integrated and interlinked mobility fulfilment. It will become less necessary to settle on just one mobility principle (owning vs. sharing, self- or automated driving, local public transport vs. private). Instead, technological developments will make it even easier to actually use comprehensive and networked mobility solutions. A prerequisite for this is the understanding that there are many solutions that can be interlinked in a problem-oriented manner, even if they've been perceived as independent from one another thus far. Or put another way: thinking in insular mobility or either/or categories limits the possibilities of comprehensively linked, smart mobility. **Thinking in flexibly configurable mobility solutions opens up considerable opportunities and allows a new type of mobility, from which new opportunities arise both for users and those organising the system.**

As such, scenarios are conceivable from the users' point of view (as an example) in which they use sharing models although they own their own car, or prefer individual use for a weekend excursion, while the potential of an autonomously driving vehicle, such as a robot taxi (for instance), is valued for business-related travel so as to use the time gained for working. The more insular thinking is abandoned, the more very new, comprehensive mobility behaviour patterns will become established, based on efficient and effective combining of existing mobility concepts.

From the organisers' or providers' perspective, the opportunity – and simultaneously the challenge – is that they must develop strategies and business models, models previously designed for individual transport, which are now focused on comprehensively linked mobility demands. Developing this new type of mobility doesn't automatically mean that existing business models are obsolete or that – as has been mentioned repeatedly – existing players, such as OEMs in particular, will have fewer opportunities in the future. Instead, it means that all the stakeholders of future mobility fulfilment are faced with the challenges of strategically considering who the customer is in this sort of mobility scenario, the needs of end customers, and how to successfully integrate the stakeholders' own mobility solutions into this type of mobility scenario.

» Various vehicle manufacturers and mobility services providers must join forces on common platforms.«

▲  EXPERT



This leads to another important challenge: meaningful technical integration, especially organisational integration, of existing mobility concepts – both within an insular mobility category as well as between the present insular mobility categories. For instance, various sharing offerings (cars, scooters, bicycles) can be interlinked and these offerings can be combined with local public transport offerings. **Over the long term, this could form a pool of sharing vehicles that can be combined with one another and with local public transport, integrated with autonomous vehicles such as robot taxis, and thus allowing the desire for individual driving at the same time.**

In connection with the technical and organisational integration of the various mobility solutions, interface design and management presents another relevant challenge. This firstly refers to the interface between the various mobility offerings, and secondly to the interface between the different and in part contrary contexts in which mobility solutions are demanded.

This is where differentiation between urban mobility and transport in rural areas plays an important role. Mobility needs in and outside the city are naturally quite different and thus place different demands on the mobility offerings and their integration. Contingent upon this, urban mobility can be more easily planned than transport in rural areas, where leisure travel in particular represents a high degree of uncertainty. The challenge is fine-tuning the above-mentioned interlinking of mobility concepts and their integration to the respective demands and conditions of city and rural living, and the further interlinking of urban and rural mobility into a comprehensively conceived mobility system.

## TO WHAT EXTENT DOES COORDINATING MOBILITY THROUGH COMPREHENSIVE MOBILITY PLATFORMS LEAD TO AN INCREASE OR REDUCTION IN ACTUAL TRAFFIC CONGESTION?

→ *The majority of experts view integrated mobility platforms as an appropriate instrument to more efficiently organise passenger transport through wider utilisation of the various modes of transport and intelligent traffic management. At the same time, the experts assume a decrease in the number of privately owned cars, which would substantially reduce pressure on transport infrastructures in the future.*

84

➤ ADDITIONAL QUESTION FOR THE EXPERTS

The question of suitable technical and organisational infrastructure and that of interface management leads to the future role of platforms that are able to realise all these things. The platforms must present the variety of offerings and make the configuration of these offerings possible for users without media disruption. Which platform will be functioning in this area, whether one or several will become established, and, above all, which stakeholders will play central roles remains uncertain. Developing some sort of meta-platform, which links existing platforms, is also conceivable. It is up to mobility solutions providers and other stakeholders to think beyond the shorelines of their various islands and jointly develop integrated concepts.

Thinking about comprehensive mobility systems requires mobility solutions organisers and/or providers to critically review their mobility offerings, ones that have come into being in an insular framework. Three main questions arise as a result: Which mobility solutions can be offered by the individual stakeholders (OEM, sharing pool, local public transport, etc.)? Which additional mobility services could be offered by the stakeholders in order to sensibly complement the envisaged comprehensive mobility system? Which previously offered services could be replaced by other mobility offerings? Specific examples for this could include for instance substituting local public transport services with autonomous transport systems such as robot taxis.

Expert Question (498 respondents):

# INSULAR THINKING AND EITHER/OR CATEGORIES **CAP THE ABILITY TO FULLY EXPLOIT THE POTENTIAL OF NEW MOBILITY CONCEPTS.**

→ All questioned mobility experts (n = 498); the missing value to 100% = no answer; the proportion of agreement is represented as "Top 2" answers ("Agree completely", "Mostly agree")



One important challenge is designing the underlying technical infrastructure. It must realise the required integration and interlinking of mobility services so that customers gain uncomplicated access to mobility, with the transaction remaining as simple and as user-friendly as possible, particularly as regards selection, configuration, and payment.

The required rethinking from traditional insular mobility categories to a comprehensively conceived mobility concept represents a process of change that must be realisable both organisationally and technically, and ultimately be accepted by users.



**59%**  
OF THE INTERNATIONAL EXPERTS (N = 498) AGREE ("TOP 2")

24%

14%

Agreement by **COUNTRY**

64% Germany

43% Europe without Germany

49% USA

Agreement by **INDUSTRY**

59% Mobility

55% ICT\*

74% CS\*\*

55% Education



5 / 85

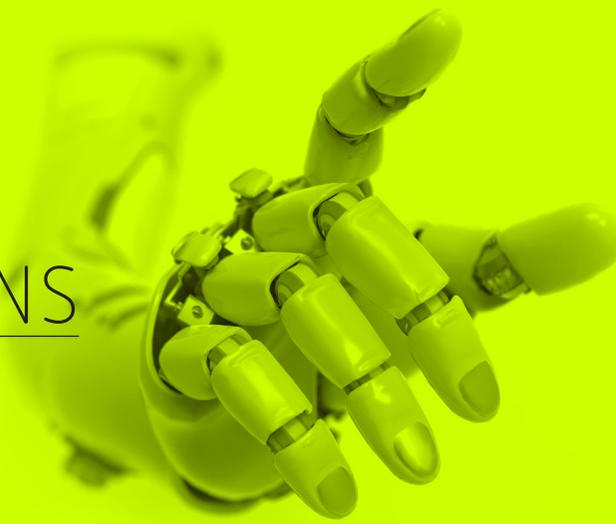
CHALLENGES FOR MOBILITY SYSTEMS IN CHANGE

\* Information and communication technology

\*\* Corporate services

# 5.2

## RECOMMENDATIONS FOR ACTION



### DEVELOPING THE TECHNICAL AND ORGANISATIONAL INFRASTRUCTURE

The development of the technical and organisation infrastructure that allows the interlinking or connection of various mobility solutions – and thus a comprehensively conceived mobility system – is necessary. This includes designing the technical interfaces, developing appropriate invoicing systems, collecting and processing data, and other system components that simplify the use and configuration processes. This also includes developing applicable concepts that enable the organisational and legal connections. The goal must be for users to easily and flexibly configure their individual mobility solutions from a continuum of mobility offerings, and that the processes for configuration, use, and payment processes remain convenient and operate smoothly. This type of settlement, without a break in media, may also require services that don't yet exist. This creates space for start-ups and entrepreneurial ideas that can be supported and accelerated with targeted funding programmes. #



### INCENTIVES FOR COOPERATION

A comprehensively conceived mobility system calls for more cooperation than traditional insular thinking does and involves multiple levels. At the level of the offerings, cooperation with other mobility providers and thus competitors is necessary. At the level of technical and organisational infrastructure, cooperation is required particularly for designing the technical interfaces, but also for questions of invoicing and data collection, use, and transfer. Such cooperation could lead for instance to developing common platforms to provide the necessary organisational/technical infrastructure. Cooperation may also be associated with the use of infrastructures. For example, sharing concepts could pertain to transport providers or vehicles, and also to physical infrastructures (rails, transport systems, etc.), underscoring the concept's all-inclusive approach. This requires a rethinking, moving away from insular thinking to a more integrated approach. Cooperation can be supported by targeted incentives.

These can include tax incentives or promoting cooperation projects, e.g., between sharing providers and local public transport with direct financial support. Analogous to other support programmes, a “digital mobility system bonus” could be paid. Developing new mobility concepts could also be directly funded if there is cooperation with other providers or stakeholders from the very start. Against the backdrop of objectives for an integrated mobility system, such stakeholders could include municipalities, cities, larger administrative bodies, or even larger corporations so that intra-urban mobility systems support overarching Smart City planning goals. Ultimately this funding is to develop new mobility solutions, always considering the comprehensive nature of mobility, and to establish necessary or sensible cooperations. #

## ⇒ INCENTIVES TO INCREASE ACCEPTANCE

Concepts must be developed to promote and/or increase acceptance or social awareness of a comprehensively conceived mobility system. This applies equally to both consumers/society and providers/companies alike. Specific approaches for users are for instance simple and transparent pricing models that allow configuring various mobility concepts and changing between them, and particularly simple user interfaces that are easy to use for individual, context-dependent configuration of mobility solutions. #



# TRADITIONAL MOBILITY PROVIDERS LOSE DIRECT CONTACT TO CUSTOMERS

TOPIC AREA

88

# 6





SUPPLIERS ARE FLYING BLIND – DO YOU KNOW YOUR CUSTOMERS?

› THESIS

TRADITIONAL MOBILITY PROVIDERS ARE  
TOO SLOW IN ADDRESSING CUSTOMER NEEDS  
SUCH THAT NEW MOBILITY ECOSYSTEMS  
WILL BE DESIGNED WITHOUT THEM.

6 / 89

› FINDING

A CUSTOMER FOCUS AS  
THE KEY FACTOR FOR SUCCESS.

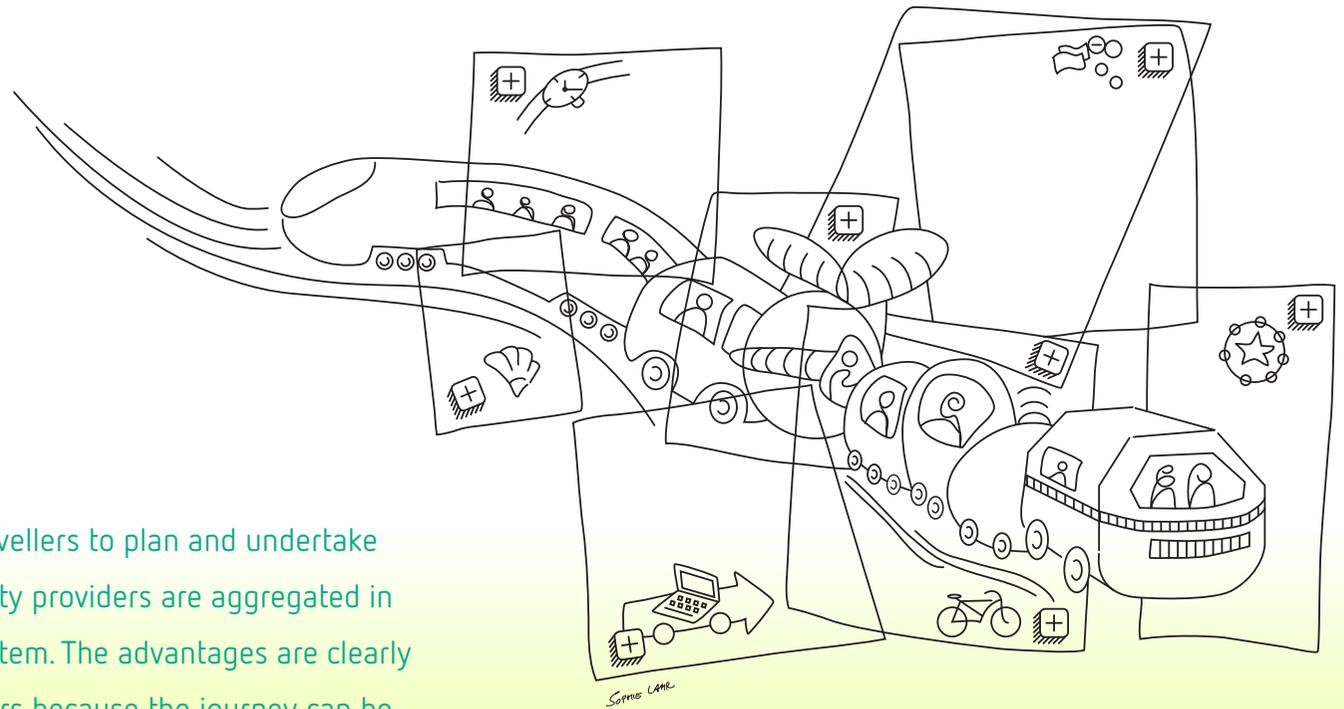
› RECOMMENDATION FOR ACTION

TRADITIONAL MOBILITY PROVIDERS  
LOSE DIRECT  
CONTACT TO CUSTOMERS





# FUTURE CONCEPT



To make it easier for travellers to plan and undertake their journeys, all mobility providers are aggregated in a digital mobility ecosystem. The advantages are clearly recognisable for travellers because the journey can be quickly and easily adapted to their needs.

Travellers only need to state their preferences while the system independently manages the booking and invoicing. There is a profile stored for every mobility offering – from self-driving electric cars to airplanes, whether in the city or in rural areas. These contain criteria such as costs for the journey, speed, level of comfort, ecological footprint, additional services, security, and liability. During the booking, these profiles are compared with the travellers needs as recorded in the system. At the same time, the digital mobility ecosystem collects data about customer preferences, which plays an important role in developing new mobility concepts.

The implementation of a policy framework for how data is handled (for instance informational self-determination) and travellers' confident handling of their own data allow this comprehensive system to become established. 5G has become a reality, whereby a wide range of services can be implemented during the journey.



NEW MOBILITY ECOSYSTEMS AND VALUE CREATION NETWORKS HAVE COMPLETELY CHANGED THE CUSTOMER INTERFACES FOR TRAVELLERS AND THUS DECREASED SHARES OF VALUE CREATION FROM ESTABLISHED PROVIDERS OR EVEN DRIVEN SOME OUT OF THE MARKET ENTIRELY. TRAVELLERS HAVE THEREFORE BECOME INCREASINGLY DEPENDENT ON THESE NEW ECOSYSTEMS AND HAVE DIFFICULTIES DISTINGUISHING BETWEEN THE ADVANTAGES AND DISADVANTAGES. THIS IN TURN LEADS TO UNCERTAINTY AND CUSTOMERS BEING OVERWHELMED.

# PROBLEM



## Evaluation of the Future Concept

As the experts see it, the growing variety of offerings makes support for the selection and combination of the transport solution unavoidable. They assume that the corresponding systems will be established, whether the political framework conditions are created or not. One expert believes that traditional mobility providers – irrespective of the sector – will have trouble remaining in customers' good graces with good hardware solutions alone.



## Feasibility of the Future Concept

The experts view open mobility solutions and open platforms as a prerequisite for realising the future concept. The problems observed in establishing such an open ecosystem are less of a technical and more of a political and economic nature. Firstly, there aren't any standards for exchanging mobility data between mobility providers. Secondly, there is a lack of incentives for providers to exchange the corresponding data. Established and new stakeholders in the mobility business seek their own positioning. One of the experts recommends a radical solution: declaring that mobility data be in the public domain, with the goal of guaranteeing freedom of people and also of personal data.

# 6

Traditional mobility providers lose direct

## CONTACT TO CUSTOMERS



» *Whoever runs the software that the customer selects OWNS the customer.* «

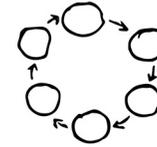
▲  EXPERT



The 2014 “future study MÜNCHNER KREIS” “DIGITALISATION: Digitalisation: Achilles’ Heel of German Businesses?”<sup>3</sup> concludes that customers and their interests determine how management takes action. The trigger for this development is, firstly, the variety of possibilities arising from digital data technologies, which allow a more exact collection of customers’ behaviours and their needs and, as a result, pave the way for customer-specific adjustments to products and services. The study further shows that the consistent orientation of offerings towards the needs of the customer, also known as user centricity, becomes an important criterion for differentiating between competing companies. Eighty per cent of the experts questioned are certain that this aspect will have the highest relevance for their companies in the year 2025.<sup>4</sup>

<sup>3</sup> <http://zuku14.de/uebersicht> (in German)

<sup>4</sup> <http://zuku14.de/kundeninteressen/> (in German)



»The growing variety of offerings makes supporting the selection and combination of transport solutions unavoidable.«



The framework conditions within which companies have aligned their value creation are being reconfigured by digitisation. One of the most important new market elements is the platforms (compare Topic Area 3 of this study), on the basis of which companies previously organised into stable value creation chains will join forces in dynamic value creation networks. Individual service packages will be combined into complex solution packages via platforms. As a result, companies are called upon to understand the meaning of so-called platform strategies in a digitised economy, and to develop strategies for embedding the company's own service offerings in such a platform-based ecosystem.

**The great challenge here is bringing together traditional product strategies and digital platform strategies.** Concepts that are successful right now are innovative network service/product packages. Their goals are a customer focus and rapid dissemination to offer customers as broad a spectrum of products and services as possible from a platform. This addresses customer needs and can also achieve customer loyalty, through which scalability and market leadership can be achieved.

On the mobility market, this upheaval is particularly evident right now. Established mobility providers are in competition with new challengers rooted in the internet economy for the interface to the customer. The mainly product-centred business models of traditional mobility providers are facing off against the platform-based business models of the internet companies.

# 6.1

## CHALLENGES



### User Centricity as Maxim

User centricity is not a new maxim; however, in 2030, the demand for user centricity has become one of the realities for companies. Innovative mobility offerings are customised to every individual person with their various interests, desires, needs, and values. Technology-driven product and service development transforms into a people-oriented development.

In 2030, “the customers” no longer exist, but instead there’s only “the customer”, Mr or Ms Smith, Jones or Taylor. **That’s because users of an intelligent, integrated mobility fulfilment system act as individual persons with specific needs and desires.** They are also perceived and attended to as such with intelligent software support. This begins all the way back in fabrication, particularly in the automobile sector, when it’s about a “collector’s item” in the high-priced segment, where owning will still play a role in the future.

There will be affordable solutions for all people’s – and goods’ – direct (e.g., “I’m getting from point A to point B”) and indirect (e.g., “I’d like to be well entertained along the way”) mobility needs and demands. This will be so precisely aligned with the individual needs that a high user satisfaction will be guaranteed. As such, it’s conceivable that a digital mobility assistant recommends to its user the appropriate mode of transport practically everywhere in the world and situationally offers pertinent environmental or consumer information. Depending on the place, reason for travel, time, and user behaviour, the user’s mobility needs will be analysed in real time and translated by the assistant into an individual informational offering.

**A new value consciousness will arise, particularly with a view to conserving resources and environmental sustainability.**

In 2030, packages could solely be delivered to district containers, whereby delivery transports can be reduced. Delivery services take on daily shopping needs and the delivery itself will take place autonomously and be digitally controlled by the recipient (compare Topic Area 9 of this study). Delivery services optimise shipments and routes. Some purchases will also be handled by the delivery service, whereby personal trips for transporting the purchases are no longer required.

Future smart services use smart data, thus creating a “lifestyle as a service”. This goes well beyond the mobility services and helps us to live our lives more simply, with optimised services available around the clock. However we must look at the other side of the coin, particularly as regards the topics of data protection and information security. Users must recognise a quantifiable benefit if they are to consent to the collection and sharing of personal data. Identity management and its protection will be of paramount importance.



### Open Platforms

Software-defined services form the nucleus of new, comprehensive value-creation networks and integrated systems. The most diverse stakeholders make these available through platforms. Unlike today, users of mobility offerings, with their various needs, expectations and demands, will take centre stage in the mobility fulfilment system. They are served individually, but automatically. **The customer interface shifts because users accept individually aligned packages of bundled products and services from a wide variety of providers.**

## »Coordination [of the mobility system of the future] will take place via app.«



Mobility will develop into a deeply individualised aspect of life. The digital generation, with a changed lifestyle, will develop integrated and networked mobility platforms. These platforms inextricably interlink integrated systems and services as well the various stakeholders. The traditional understanding of roles – producer, supplier, customer, user, service provider, or partner – will disintegrate in favour of faster and changing roles.

In the future, the “driving provider” could come from the electronics industry, since they have experience with software for large systems and encourage innovative business ideas. The relationship in attitudes about “ownership or renting/sharing” will continue to shift towards sharing, but ownership will not disappear.

**Regional, national, and European and/or global mobility tickets, intermodal information or sales platforms, and common cost schemes will develop as networked offerings and services.** This way, by 2030, portals will be able to provide users in any region an attractive mobility offering for the entire journey. The prerequisite for this is that mobility information and data is made freely available. Cooperation and open data exchange between large transport and mobility providers must be strengthened. Standardised exchange formats and program interfaces must be defined to achieve this.

In megacities such as Tokyo, New York and London, private transport might be completely replaced by autonomous sharing models by 2030. However, politicians must enact a regulatory framework applicable worldwide for the use of one’s own vehicles. The relevant international bodies must soon, before 2025, define relevant standards for interfaces that will be required for autonomous and networked driving as well as for the “digital city”.

What must be critically monitored is whether the software dependency of the new mobility technology leads to the emergence of monopolies or oligopolies. Therefore, the conditions under which such systems may be operated must be controlled at a regulatory level beforehand, and, ideally, subject to international consensus.



### Standards

Whether local, regional, national or international, intelligent mobility fulfilment systems of the future must be networked at every level and contain all conceivable offerings for products and services. At first glance this may seem like a fantasy, evocative of a system that only offers benefits, meets all needs, and fulfils all the requirements. Yet such networked, coupled products seem possible if the regulatory foundation for it can be successfully laid.

## WHERE WOULD SUCH A VISION BE MOST LIKELY TO **BECOME REALITY**, AND **WHO** WOULD BE MOST LIKELY TO IMPLEMENT SUCH A SOLUTION? PLEASE ADDRESS IN PARTICULAR THE **ROLE OF PUBLIC PROVIDERS**.

→ *In metropolises such as Singapore and Hong Kong, with their highly networked mobility offerings and payment systems, the pathway to the described future concept doesn't seem that far off. Local public transport providers will likely have difficulties in making up for the know-how deficit as compared to established stakeholders in a data-based mobility market, and their transport offerings will make an essential contribution.*

+

ADDITIONAL QUESTION FOR THE EXPERTS

Today there are no defined national or international (industrial) standards for data and information exchange between different mobility providers. Even public authorities often may not or are unable to share their data with other public authorities. Yet an effective, integrated, and intelligently networked mobility fulfilment system requires continuous transparency and open standards. This is the only way today's isolated, fragmented solutions can be overcome so that new, boundary-crossing coupled products and services can emerge.

For this purpose, politicians and businesses at all levels and across all possible bodies, as well as (self-)regulation – regionally, nationally and internationally – are called upon to define the relevant interface standards. Without the appropriate regulatory framework, it will remain very difficult to establish intelligent mobility offerings that involve autonomous and networked driving in the digital city.

Many experts assume there will be a much lower number of individual vehicles in the city compared to today, and that public parking areas will be considerably reduced. The space freed up by this could be used by local public transport to establish an effective, good-quality "fast network" in regional cooperation in order to handle the rising commuter traffic in this system.

Regionally, traffic will be mapped and managed in large data processing systems. Suitable computational processes ensure, over the short term, medium term, and long term, dependable data that can be used for intelligent traffic management. This is necessary because **urban mobility in particular will become one of the greatest challenges for an intelligent, networked mobility fulfilment system due to rapid population growth in metropolitan areas.**

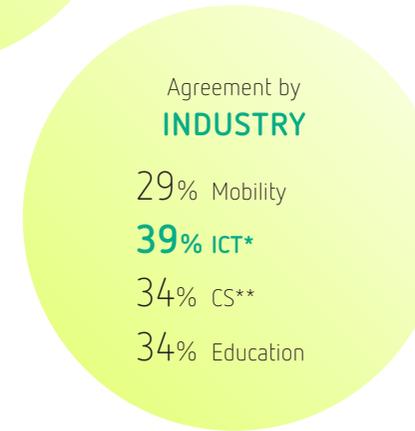
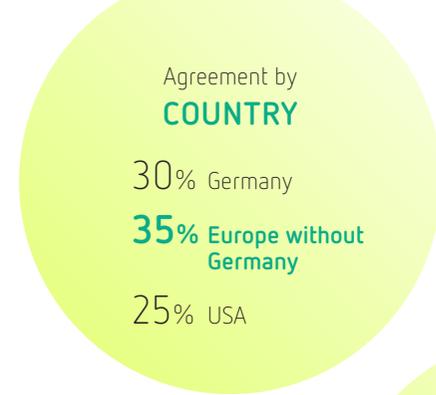
Expert Question (498 respondents):

# PROVIDERS FROM OUTSIDE THE INDUSTRY WILL DOMINATE FUTURE MOBILITY MARKETS BECAUSE TRADITIONAL MOBILITY PROVIDERS HAVE LOST THE DIRECT CONTACT TO CUSTOMERS.

→ All questioned mobility experts (n = 498); the missing value to 100% = no answer; the proportion of agreement is represented as "Top 2" answers ("Agree completely", "Mostly agree")



Yet transregional "interlinking into comprehensive, multimodal mobility offerings" is necessary, as one of the experts put it. This leads firstly to numerous opportunities for local public transport companies as well as for new local, regional, national, and international mobility services providers from the public and private sectors. Secondly, this development leads to disruptive changes for network planning and implementation.



OF THE INTERNATIONAL EXPERTS (N = 498) DISAGREE ("BOTTOM 2")

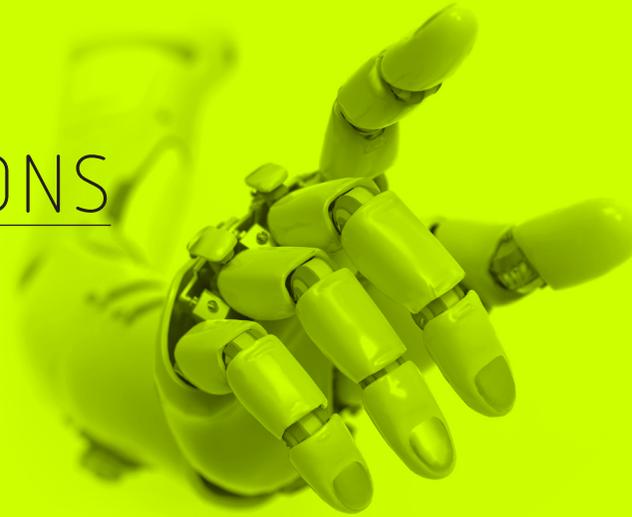


TRADITIONAL MOBILITY PROVIDERS LOSE DIRECT CONTACT TO CUSTOMERS

\* Information and communication technology  
\*\* Corporate services

# 6.2

## RECOMMENDATIONS FOR ACTION



### A FAST CHANGE IN THINKING IS REQUIRED

If traditional providers don't want to continue losing direct contact to travellers over the coming years, a fast change in thinking or taking action is necessary. In light of "user centricity", customers, with their individual demands and needs, will be having a profound impact on how offerings are designed in the digitalised "now world" of tomorrow. Mobility will develop into an extremely individualised area of daily life. Even the established change in values today, geared towards sustainability and resource conservation, must be taken into account. All mobility innovations that are developed based on these values undoubtedly have greater chances of success with future generations.

For the necessary platforms, it is imperative that the national, international, i.e., global, framework conditions be created across a wide variety of areas. Infrastructure and industrial standards must be comprehensively compiled and prepared so that competition across industry boundaries and geographical borders is possible. Ultimately it always has to come back to the user – not just nationally, but in the era of "de facto" digitalisation, it's inevitable and irrevocable, even in a global context.

»One factor for success is to view mobility as a service that can be delivered by various providers, no longer requiring an individual vehicle.«

▲  EXPERT



## SAME RULES FOR EVERYONE

A uniform regulative framework is needed, within which the competition for access and interacting with mobile customers and their data are subject to the same rules. This means that data protection and informational security must be set up with uniform standards to credibly assure users that their personal data is protected.



# ADDED VALUE

DRIVES

# MOBILITY

TOPIC AREA

100





MOBILITY IS MORE THAN JUST ARRIVING!

› THESIS

ADDED VALUE IS INCREASINGLY  
INFLUENCING THE SELECTION  
OF THE MEANS OF TRANSPORT.

› FINDING

NEW OFFERINGS ON HOW TO SPEND  
TIME WHEN IN TRANSIT WILL BE USED FOR  
GAINING COMPETITIVE ADVANTAGES.

› RECOMMENDATION FOR ACTION





# FUTURE CONCEPT



New mobility concepts win over travellers as they meet new mobility needs by clearly offering a greater breadth of added value (i.e., time for other activities, wellness, mobile working).

The respective offerings are aggregated in different classes of service, which are compared to the travellers' needs. The mobility concepts that win the most customers are those that take the least amount of time for planning the trip itself and that offer last-minute booking. Flexibility for individual requests, optional high levels of comfort, simplicity, and usability feature as central incentives. Customers generally demand that they don't have to pay any additional costs.

By consolidating various different data – including for instance preferences, traffic conditions, and availability – providers can optimally anticipate travellers' needs in various mobility situations and react to these. New offerings in the mobility sector are often initially offered free of charge to introduce travellers to the added value. Travellers are also informed about new offerings on social networks through customer feedback systems.



IN THE FUTURE, TRAVELLERS' EXPECTATIONS AND NEEDS FOR THEIR MOBILITY WILL BECOME MORE COMPLEX.  
NEVERTHELESS, TRAVELLERS CHANGE THEIR HABITS SLOWLY AND DON'T START USING THE NEW OFFERINGS UNTIL THE ADVANTAGES BECOME OBVIOUS.

# PROBLEM



### Evaluation of the Future Concept

Most experts see travellers wanting to actively use their mobility time. Work and entertainment possibilities could be offered so that travel is not viewed as lost time. If this succeeds, even relatively slow modes of transport become more attractive. Other experts continue to view the satisfaction of basic mobility needs as paramount. The new status symbol won't be the car, but rather the smart, multimodal use of various mobility offerings. The main differentiating criteria in the competition between mobility offerings will be the convenience of travel planning, booking, and the trip itself, with the additional offerings only playing a role to a lesser extent. An aid for selecting a mobility offering will be the transfer of established social media and community functionality from traditional e-commerce onto the mobility market.



### Feasibility of the Future Concept

Experts believe that the underlying data necessary for implementing this future concept, which allows for reliable statements about travellers, their objectives, and their preferences, is currently non-existent. Only when it does exist can additional offerings be developed. In at least one expert's opinion, these offerings are not yet in sight.

# 7

## ADDED VALUE DRIVES MOBILITY

➡ The pinnacle of “covering the distance between points A and B” was presented to us back in the 1960s in the science-fiction series *Star Trek*: teleportation, or changing the location of materials from one moment to the next. Since teleportation isn’t affected by spending time crossing space, the “how” of the trip has no meaning for travellers. But until technology is advanced enough, this “how” will continue to play a substantial role. Since travellers are being divested of their control tasks through technological developments in the area of assistance systems or autonomous driving, the solutions mobility providers offer for the use of this newly-gained time will become central criteria for distinguishing among competing providers.



» *Students will learn with online lectures during a trip and not just be playing with their cell phones.* «

▲  \* EXPERT

# 7.1

## CHALLENGES

### WHICH **MOTIVATORS** MIGHT CONTRIBUTE MOST TO THE **USE** OF THESE SYSTEMS IN THIS **SCENARIO**, AND WHICH **ADDED VALUES** MIGHT BE THE STRONGEST **DRIVERS**?

→ *Experts refer less to the added value that complementary services could offer during travel and instead view traditional aspects such as money or time savings and comfort as the primary motivators. Additional motivators mentioned include availability, dependability, security, environmental friendliness, and cleanliness.*

▲ **+** ADDITIONAL QUESTION FOR THE EXPERTS



Speed or the question of costs mustn't always be the deciding factor for selecting a transport offering. **Competitive differentiation on the mobility market today, along with price, also takes place with the exclusivity of the offering, the offered comfort, travel speed, or the offering's flexibility.** Business travellers who make a round trip in a day have different demands on the quality of the mode of transport than for instance a five-person family with an infant going on holiday. The demands for energy efficiency or the "experience" of the trip involve differentiation possibilities that the mobility industry must address. While intermodality – the combination of different modes of transport – allows the increase of availability, convenience, and efficiency, it affects each person differently. Particularly when considering an ageing society, the number of transfer points, walking distances, and baggage handling could be decisive factors for needs-based mobility services.

The travel dimensions of time, costs, and conveniences can be as relevant as the possibility of working on the trip, barrier-free transfers, luggage that is easy to handle, reliability, and so on. Differentiation possibilities open up in transport modes and in additional features (meals, Wifi, entertainment programme, group-friendly seating, etc.) that can also be arranged on digital

platforms and sold through digital channels. **Services that go beyond and complement the transport functions provided by mobility suppliers could be pivotal for selecting a mobility offering.** This “transport + x” represents a variety of different, individually customisable services that travellers can access during the journey. The additional services could be time-saving (e.g., working, continuing education, organising everyday tasks, producing piece work, maintenance tasks) or to pass time (e.g., relaxation, reading, listening to music, an opera, etc.). A variety of possible mobility offerings emerge through digitisation, both for the question of how the distance will be covered and how the time will be used. Digitisation allows customer-specific combinations of manifold possibilities.

As a result, users benefit from the variety of offered possibilities, which stretch across several dimensions and are individually configurable. These multifarious dimensions give rise to a value-creation network that hasn't existed previously. For companies, this opens up quite novel possibilities and variations for positioning. For example, while “specialists” could take a more vertical orientation by offering special trips (e.g., a trip on the Trans-Siberian Railway, including a period initial departure in a classic car, a carriage, or in a propeller plane with country-typical catering), or a horizontal one where they allow multifunctional seats for trains, planes, and automobiles with customised seat adjustment and comfort functions for work, play, and relaxation. The spectrum of specialisation and differentiation opportunities is large and will certainly become even larger – particularly with evolving customer requirements. This in turn forms an ecosystem that models the mobility fulfilment system as a wide spectrum of services, providers, modes of transport, and complementary products and services. The market entry options listed here aren't only available for traditional stakeholders in the digital world, such as powerful internet multinationals.

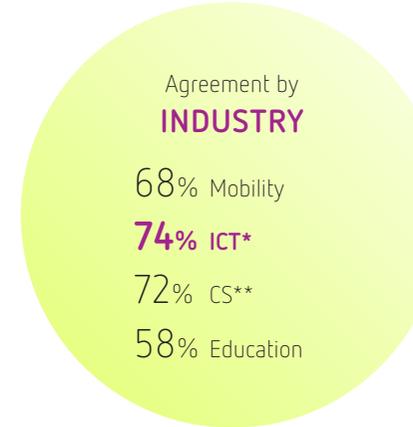
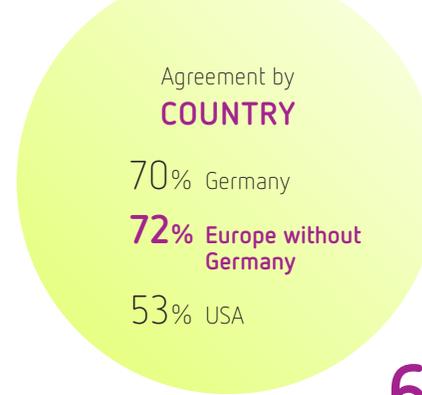
**For companies in Germany in particular, considerable opportunities arise as established brands can represent dependability, speed, and style for complex digital services.** This would require establishing cooperations with those stakeholders that have the appropriate digital expertise or the pursuant customer access. But supplier options could be expanded with the same attributes if they provide for the requisite networking within and between transport modes. Both security and data-protection-oriented solutions could take advantage of partners in the ecosystem wanting to protect their image and not wanting to scatter data among other companies in the same ecosystem.

Overall, digitalisation allows individual configuration of a variety of mobility dimensions that includes straightforward transport, and services that go beyond this, which for companies opens up novel opportunities for further development and innovation. Recognising these and exploiting their potential is an essential strategic task for all mobility providers in the future. From the users' perspective, there is always the possibility to combine means of transport, quality of said transport, and additional services according to personal and situational requirements. The emerging services will be linked through a platform, the success of which will be dependent on the satisfaction of the user.

Expert Question (498 respondents):

# PEOPLE'S MOBILITY NEEDS THAT GO BEYOND PURE MOBILITY WILL BE THE DECISIVE FACTOR FOR SELECTING A MOBILITY OFFERING IN THE FUTURE.

→ All questioned mobility experts (n = 498); the missing value to 100% = no answer; the proportion of agreement is represented as "Top 2" answers ("Agree completely", "Mostly agree")



7/107

ADDED VALUE DRIVES MOBILITY

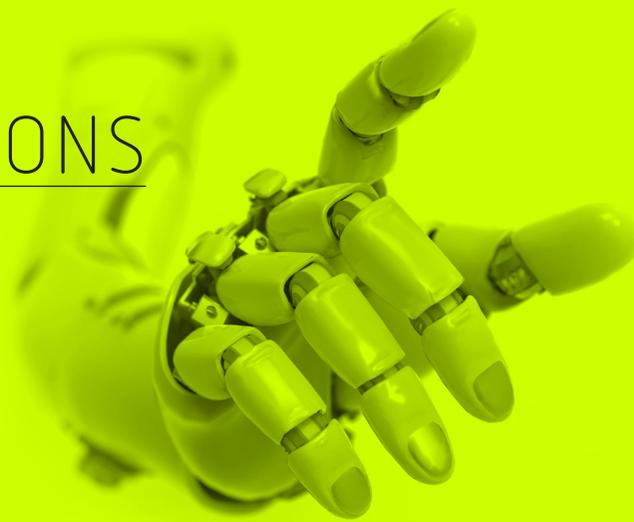


\* Information and communication technology

\*\* Corporate services

# 7.2

## RECOMMENDATIONS FOR ACTION



### FOCUSING ON THE APPROPRIATE ROLE IN THE ECOSYSTEM

Mobility behaviour and offerings are already changing and becoming more diverse. This trend will continue – both as respects the area of pure transport and offering additional services.

In a growing value-creation network of services of various dimensions, companies in the affected industries must create innovative offerings that fit into the ecosystem while exploiting technical innovations. They can take on different roles in this process:

- Integrator – create a complete, separate ecosystem
- Aggregator – take up a key intermediary position in the ecosystem
- Specialist – focussing on a differentiated core business

Which roles they take ultimately depends on many factors, including the company's size, market power, offerings, etc. What seems important is to focus on one role and continue to concentrate on it when developing strategies, offerings, finding appropriate partners for cooperations, and so on. Cooperation partners will also play an important role. If the know-how is lacking – for instance as regards user experience or the necessary digital expertise – cooperations are important, also in the sense of cooperation. #

*»The use of travel time as active time for working and living will be an important factor for success for a growing number of people.«*

▲  EXPERT

## JOINT CREATION

If the variety of dimensions for transport and for additional services grows in an emerging ecosystem, aspects of the fundamental needs for daily life may be affected and must be reconceptualised. It is imperative that public institutions enter into a discourse with private companies. The goal must be to understand the degree of technical innovation and the emerging business models so as to develop common models that sufficiently address social needs. Exploitable opportunities may lie in joint creation. It is necessary to investigate which possibilities may exist by setting up targeted incentives, development programmes, or by supporting suitable start-ups. #

## REGULATION

Sectorial regulation of cars, public transport, aviation, etc. is needed to give the new mobility fulfilment system a common framework and to govern the coexistence of the options. Over-detailed prohibitions and precepts obstruct innovation and quickly force the "digital", data-based components of a mobility ecosystem abroad. Instead, the opportunities arising through combining suitable solutions for transport + x should be actively promoted in the future. #



POTENTIALS FOR

# MOBILITY AVOIDANCE

› TOPIC AREA

110





VIRTUAL MOBILITY SUBSTITUTES FOR PHYSICAL MOBILITY!

› THESIS

IT'S ALSO GREAT  
WITHOUT PHYSICAL MOBILITY—  
AND IT WORKS.

› FINDING

VIRTUAL MOBILITY IN A PROFESSIONAL AND  
PRIVATE ENVIRONMENT MUST BE UNDERSTOOD  
AS A REAL ALTERNATIVE TO PHYSICAL MOBILITY.

› RECOMMENDATION FOR ACTION

8/111

POTENTIALS FOR  
MOBILITY AVOIDANCE

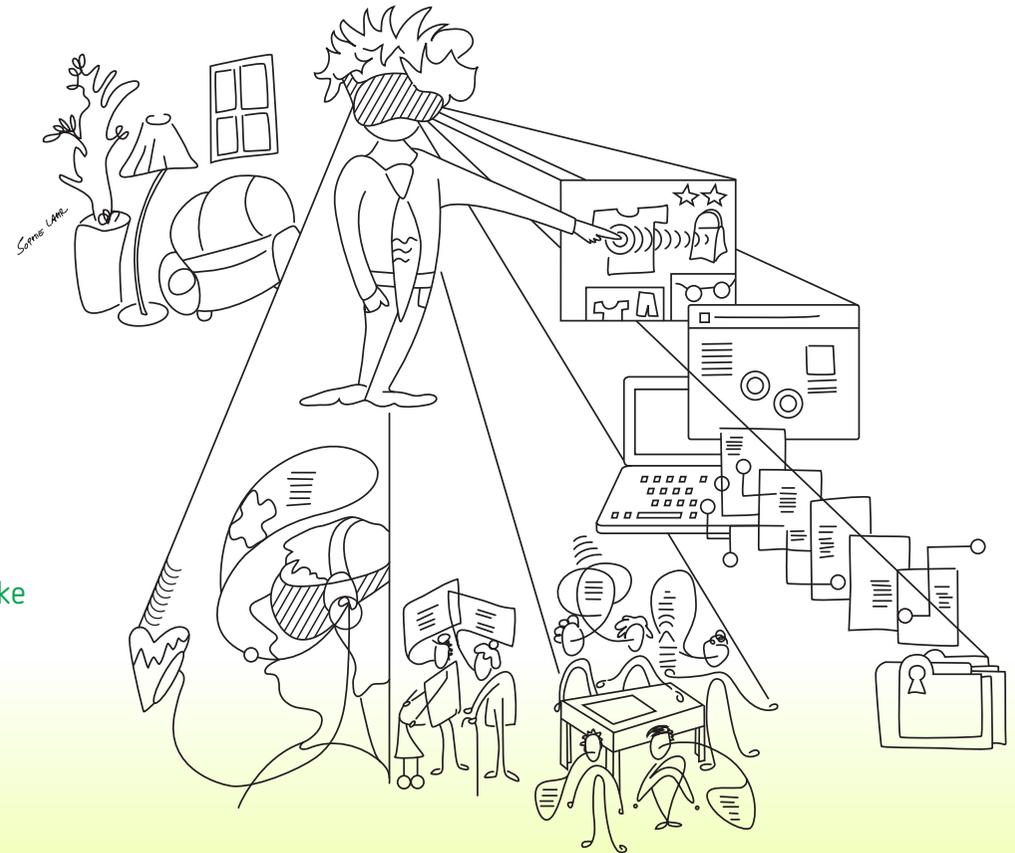




# FUTURE CONCEPT

The use of virtual and augmented reality enables new dimensions for travel activities that in turn make carbon-neutral travelling possible. 3D glasses and holograms generate a virtual space that depicts communication partners so realistically, it creates a feeling of direct interaction for all participants.

This results in social opportunities for meeting that could replace conventional travel, both in private and business contexts. Private travellers utilise these new opportunities to quickly cover distances (for instance going to a supermarket, meeting their grandmother, or keeping a doctor's appointment). The use of this new technology for companies leads to huge increases in efficiency because the time for business trips is kept to a minimum, making it possible to attend several meetings quickly. These new technologies also facilitate new forms of working: long and carbon-dioxide-intensive commuting become a thing of the past, and home offices or short-term renting of co-working spaces become everyday occurrences, replacing compulsory physical presence in central offices.



Socially important meetings, whether for personal or business reasons, still take place with direct contact. Due to the significant cost savings, the simplicity of handling, and user-friendliness, these new communication technologies and media (e.g., video conferencing and 3D) become an integral part of everyday life.



INCREASING CLIMATE CHANGE  
AND THE RESULTING NEGATIVE  
IMPACTS ON DAILY LIFE LEAD TO  
STRICT WORLDWIDE REGULATIONS  
ON PRIVATE AND COMMERCIAL  
TRAVEL IN THE FUTURE.  
EVERY SINGLE PERSON IS  
COMPELLED TO TRAVEL IN A  
CARBON-NEUTRAL FASHION –  
WHETHER FOR BUSINESS OR  
FOR PLEASURE.

# PROBLEM



### Evaluation of the Future Concept

The experts see digital technologies as having a great potential for avoiding physical mobility, yet consider it in very nuanced ways. For business communication, not every personal interaction can be virtualised. Personal contact for building trust remains indispensable, depending on the specific situation and the individual's background (i.e., culture). Personal conversations will remain the most important means of communication in the future, and direct, personal interaction will not be completely replaced by videoconferencing or virtual reality.



### Feasibility of the Future Concept

Experts agree broadband networks must be expanded before this future concept can be comprehensively realised and accepted. A high-resolution image and good sound are not enough in and of themselves since humans gauge speaking situations with more than just their eyes and ears. Future solutions must also speak to other sensory organs, such as touch. At the same time, the solutions must be affordable for consumers and companies.



## Potentials for MOBILITY AVOIDANCE

*»The increasingly functional mix of the urban habitat allows working, living, and leisure activities in close proximity to one another and thus contributes to transport avoidance.«*

▲  \* EXPERT

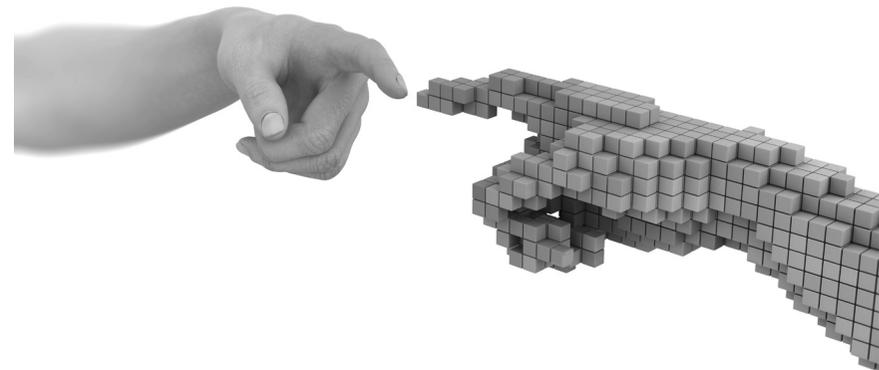


Over the past two decades, numerous digital technologies have made their way into people's everyday lives. Messaging services and social networks have massively altered interpersonal communication. Telemedicine offerings can prevent unnecessary trips to the doctor. Videoconferencing is used to simplify coordination processes between teams working around the globe. The internet, in combination with mobile devices, makes it possible to carry out a number of everyday tasks (e.g., work duties, grocery shopping, consuming media) from anywhere in the world.

In 2025, technologies such as virtual reality and augmented reality will be an inherent part of people's everyday lives due to sharply reduced costs and user-friendliness. With a view to the global challenge facing humanity – climate change – these and other digital technologies offer promise for reducing personal mobility to address one of its biggest causes.

»While one-on-one conversation will remain the most important means of communication, solutions based on augmented reality will play a large role in the future.«

▲  EXPERT



The avoidance of physical mobility through the use of virtual mobility can be attractive for economic, health, or social aspects. In a work context, the use of virtual instead of physical mobility can save on carbon-dioxide emissions and travelling costs, and also make more effective use of employee's work time. Working in shared offices at the margins of metropolitan areas instead of in city centres allows commuters to avoid onerous, stressful traffic jams to spend time with, for instance, family.

While alternative propulsion technologies and regenerative energy sources for the transport of the future are being developed and are the subject of public debate, concepts for mobility avoidance are almost exclusively seen in connection with the sharing economy. The exemplary overview of the possibilities of avoiding mobility in various areas of life shows that smart technologies boast significant potential.

# 8.1

## CHALLENGES



### Mobility avoidance by shifting from virtual communication to virtual interaction in social life

Social networks, instant messaging, and video chats have changed communication, especially in personal lives. With their assistance, people who live separated by time zones can stay in close and regular contact. While today's technologies still take a back seat to direct interpersonal communication, immersive communication technologies such as augmented or virtual reality will have relevantly changed human communication by 2025. Right now, in 2017, these technologies are still in their infancy. By 2025, they will have become everyday things, both at work and in people's daily personal lives. The potential of mobility avoidance ties in to the future possibility to generate nearly realistic physical impressions with virtual technologies and also represent virtual interactions with 3D representations of virtual spaces. One possible application could be personal conversations in the virtual representation of one's own home without physically having to be there.

**Innovative technologies such as AR and VR will represent a realistic and affordable means for virtual personal communication through the combination of visual, auditory, and kinetic representation possibilities for many scenarios.**

Larger potentials for avoiding mobility could result from thinking beyond the substitution of communication through virtual technologies and focussing on interactions. Another reduction in physical mobility in social life will only be possible when joint interactions are supported or made possible by digital and virtual technologies. A trip that previously could only be taken physically, such as going to Lake Garda – right down to enjoying an espresso – will be nearly completely substitutable by a virtual representation.

In this respect, future virtual interaction using digital technologies will certainly have relevance for mobility avoidance, even if direct personal interaction will remain the most important type of communication for people's social lives, especially with experiences important to human needs for trust, raising children, or in partnerships that digital technologies cannot replace.



### Working and organising run smoothly, even without physical mobility

As compared to social life and leisure time in particular, the technologies' potential leverage for mobility avoidance in the working world is enormous. A multitude of routine work and organisational tasks can be handled by smart digital assistants, without additional human intervention, thereby contributing to mobility avoidance. Travel costs and user preferences, meeting rooms, hotel rooms, guest presents, and flight tickets can all be automatically booked, based on appointments in a work calendar and dependent on availability. Autonomous vehicles will allow for interim meetings or research during travel to the next customers, which in combination with sharing measures can contribute to reductions in travelled distances (more on this in Topic Area 5).

**Hardly any occupational group or professional category will remain untouched by the changes caused by innovative digital technologies as part of the digital transformation.** This is where the greatest potential for mobility avoidance lies. It depends to a large extent on the necessity of real interactions. In particular, social, cultural, or place-bound service careers, including nursing care, supervision, and education, either have no or very limited potential for mobility avoidance because there are hardly any possibilities for virtual substitution of these activities, and social acceptance of this is more difficult to establish than in other areas of life. Despite this, the key to mobility avoidance in the digitisation of value creation is located here. If every part of value creation, from development to after sales or recycling, is digitally supported or can be digitally performed, physical interactions are often no longer necessary. Taken together, the use of digital assistants and digitisation of value creation is recommended for future mobility avoidance.

**Under the maxim of increasing productivity and cost efficiency, and future legal obligations to reduce greenhouse gasses, economising on business travel represents the most obvious potential for mobility avoidance.** For some occupational groups, real interactions are only situationally required. Technologies such as augmented reality can support work by providing information and being able to analyse visual information. Some examples: for assessments or repair work, smart glasses can help incorporate digital assistants or even human experts without these having to be present on location. Auxiliary specialists no longer need to be in the field, but instead can be involved using augmented reality. For repair work, replacement parts often aren't immediately available and traditionally cannot be ordered and delivered until after the diagnostics have been completed. Using 3D printers, replacement parts could be manufactured directly on location and in real time so that any additional journey or other logistics are no longer necessary. Repair work could be fully completed more quickly and with just one visit to the workshop. With predictive maintenance, routine inspections of machines and plants could be completely eliminated. The machine's or plant's condition is captured by digital sensors and a computer system calculates the

optimal point in time for necessary repair work. Service personnel are only commissioned when there is an actual need for maintenance. These examples indicate the considerable potential that exists for careers in services out in the field, logistics, in construction, development and in other services in the technologies mentioned. **Many activities that previously involved physical mobility can be substituted with virtual mobility or technological innovations. In jobs that do not require actual interaction, such as project work, interactions and exchanges between project partners could occur solely through video chats or communication supported by virtual reality.** Contracts could be signed with digital signatures, negotiations could take place with realistic virtual representations of the participants. The physical mobility of these activities can be completely replaced by virtual mobility.

In the area of working and organising, the leveraging effect for mobility avoidance is at its greatest through a combination of measures. As with predictive maintenance, it is the combination of technological and organisational changes. The topic of co-working is worthy of mention. In the 1970s, there were experiments with co-working offices in peripheral areas and teleworking, but not until 2025 will it be possible in most cases to work from home or in community offices without being shut out of the many communication and interaction possibilities of a fixed workplace. **Travelling times for commuters can be considerably shortened by establishing communal co-working offices.** To be able to work there, employees must be able to remotely access their data in the cloud and have the relevant communication technologies, such as virtual reality glasses. As per the sharing economy approach, co-working means that all workers in a particular commuting area have access to these offices, not just employees of a single company. Beyond just the travel time, in this model overall traffic at peak times can be reduced due to shorter travelling distances. The targeted establishment of co-working offices in economically underdeveloped areas promises special benefits for reducing traffic in urban areas. The combination of organisational measures (e.g., co-working, home office, mobile working) with innovative technologies

## HOW IMPORTANT WILL THE “HUMAN ELEMENT” AND/OR DIRECT PERSONAL COMMUNICATION BE IN THE FUTURE?

→ *If this future concept comes true, direct personal communication will become a scarce asset. Perhaps the value of such encounters will increase because of this, and the mix will be reversed (personal encounters with simultaneous virtual absence for permanent availability)? As a matter of principle, direct communication remains the most important art of human communication; however, digital technologies could expand direct communication and interaction.*

+ ADDITIONAL QUESTION FOR THE EXPERTS

(e.g., AR) is effective for mobility avoidance. To achieve this, it must be accompanied by amending the legal framework for home offices (e.g., jurisdiction of the teleworking laws) and the promotion of acceptance for mobility-avoiding forms of work, even if it involves a loss of control and a stronger need for result-oriented management.

### ➡ Virtual consumption of goods and services relieves the strain

Technological innovations, like the use of AR to virtually try on clothes as a novel sales channel, are, from today's standpoint, a first step towards creating potential for mobility avoidance. **3D printing can contribute greatly if customers can print goods at home, or logistics services providers can produce the ordered goods in close proximity to customers.** This can reduce or eliminate numerous shipments. **3D printing would thus promote the re-urbanisation of production.** In addition, another change in consumer behaviour is apparent.

There is also immense scope for avoiding physical mobility for goods that cannot currently be consumed virtually. As in the area of working and organising, there's leverage to be found in the structural organisation. Purchases in retail or in supermarkets can already be made through e-commerce platforms. However, it has been established that the transport efforts initially increase, even though not every customer must drive their car to the supermarket.

Expert Question (498 respondents):

# NEW TECHNOLOGIES (E.G., VIRTUAL REALITY, HOLOGRAMS) WILL REPLACE PHYSICAL MOBILITY WITH VIRTUAL MOBILITY IN THE FUTURE.

→ All questioned mobility experts (n = 498); the missing value to 100% = no answer; the proportion of agreement is represented as "Top 2" answers ("Agree completely", "Mostly agree")



Orders could be sent through distribution centres so that logistics services providers could bundle shipments of goods to minimise transport routes. The dematerialisation of consumption, for instance through streaming, represents a main driver of mobility avoidance because songs, films, and books can be transported and consumed in digital form, thus avoiding the necessity of physical transport. The same applies to video games. Mobility can also be avoided when companies produce locally and use innovative technologies such as 3D printing, and when consumers decide to favour digital or virtual options over material ones.



45%

OF THE INTERNATIONAL EXPERTS (N = 498) DISAGREED ("BOTTOM 2")

25%

29%

0%

8/119

POTENTIALS FOR MOBILITY AVOIDANCE

Agreement by COUNTRY

27% Germany

28% Europe without Germany

30% USA

Agreement by INDUSTRY

23% Mobility

35% ICT\*

26% CS\*\*

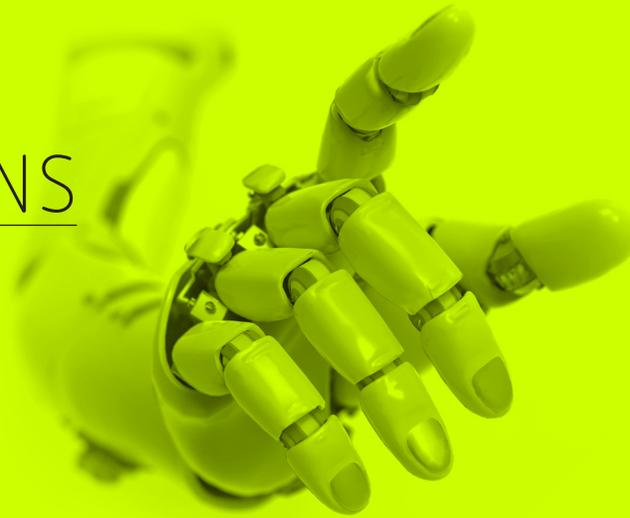
36% Education

\* Information and communication technology

\*\* Corporate services

# 8.2

## RECOMMENDATIONS FOR ACTION



### NO DISADVANTAGES

For all the potential of mobility avoidance, what must always be considered is that no disadvantages may result for people pursuing it. This applies to their social lives and consumption, and particularly to the areas of work and organising. Mobility avoidance concepts will only be successful and accepted when employees can do their jobs better or more autonomously using these new technologies. Potentials for avoiding mobility emerge where virtual interactions take place using digital technologies. In the areas of work and organising, digital assistants in particular offer the possibility to automatically carry out routine tasks. In short, the digitisation of value creation, which can be promoted through 3D printing, for instance, contributes greatly to mobility avoidance. The use of augmented reality is particularly suited for support work.#



### INTELLIGENT COMBINATION OF MEASURES

However, digital technologies shouldn't be considered to the exclusion of other things. Greater synergies can often result from the combination of organisational measures and digital technologies, for instance using virtual reality in the home office. This will only work if there are accompanying amendments to the legal framework for home offices. Mobility can be avoided if both companies and consumers accept the use of digital options and make a conscious decision to use them. In an increasingly virtual world, physical interactions will become a scarce asset and thereby more valued. The feasibility of physical mobility avoidance pushes people's limits concerning the indispensable physical human contact of social life. #

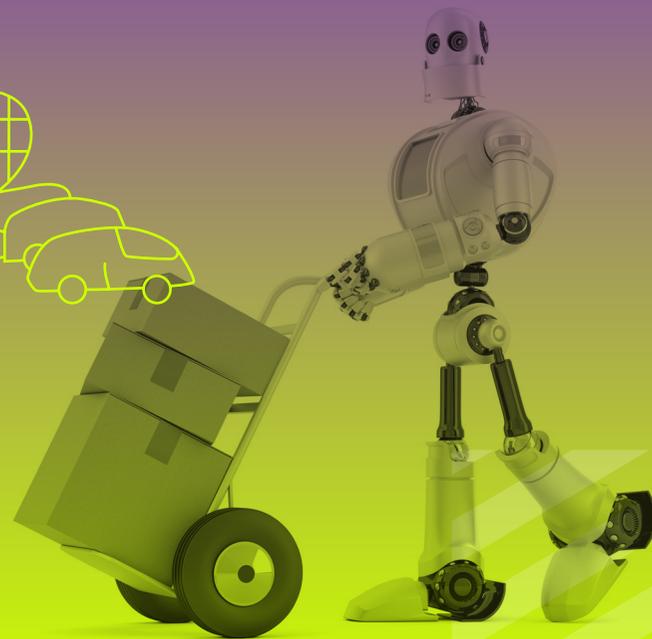


*»The problem of personal transport's energy needs makes a compelling case for increasing transport's virtualisation, particularly considering climate change.«*

▲  EXPERT

# GOODS TRANSPORT IN RADICAL TRANSFORMATION

TOPIC AREA





COMING TO A GRINDING HALT – GOODS AND PEOPLE COMPETE FOR TRANSPORT SPACE.

› THESIS

LOGISTICS DRIVES FUTURE MOBILITY INNOVATIONS.

› FINDING

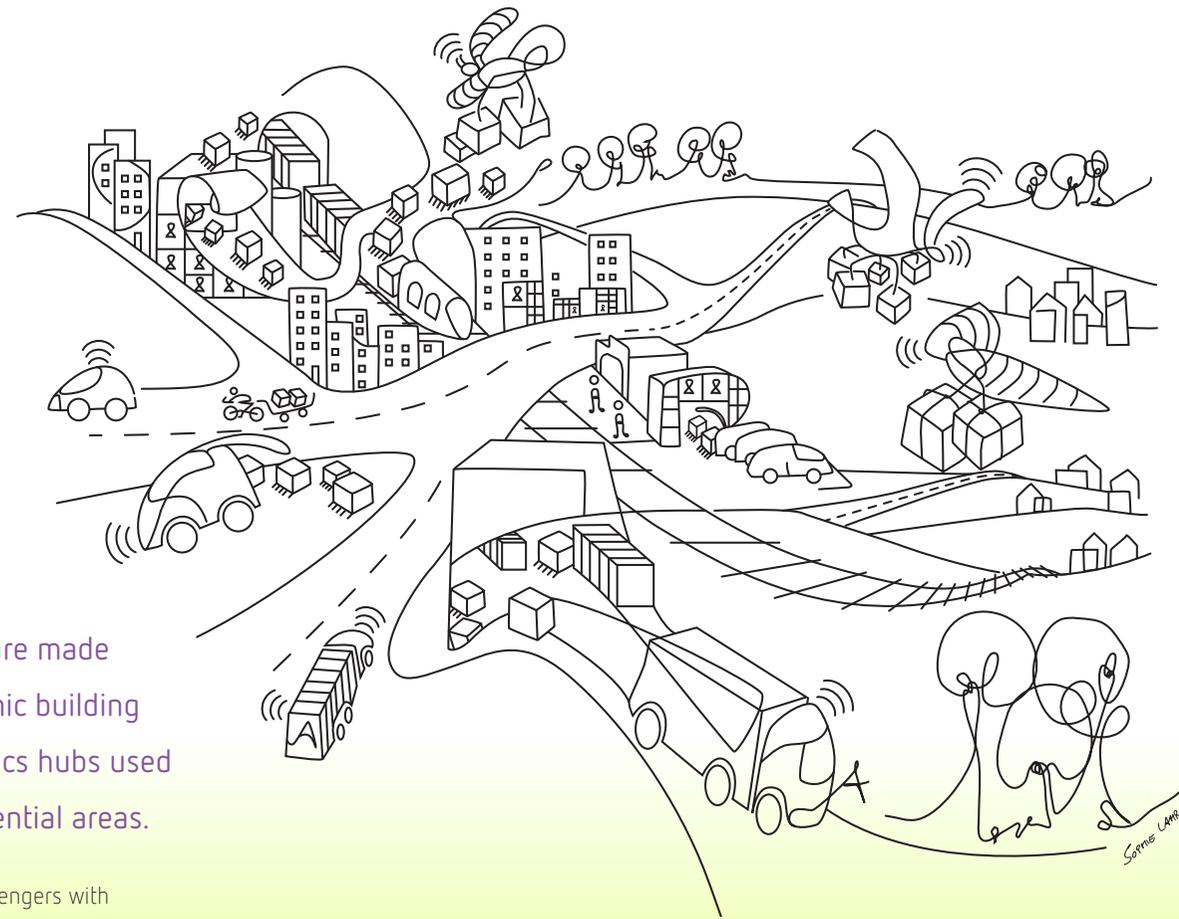
INDIVIDUAL AND GOODS TRANSPORT IN THE SMART CITY MUST BE OPERATED AS AN INTEGRATED NETWORK.

› RECOMMENDATION FOR ACTION





# FUTURE CONCEPT



Deliveries within an hour in urban areas are made possible through widely available electronic building lockers and various neighbourhood logistics hubs used as temporary storage facilities near residential areas.

The distribution of goods involves an integration of messengers with electrically supported cargo bikes, new taxi concepts, and bundled logistics distributors. Rail and local public transport have also been integrated into goods logistics. The periphery of urban areas is efficiently connected to these networks through train stations, mobile package stations, and park-and-ride facilities as distribution points. The response to these massive increases in the trans-regional flows of goods has included the pooling of larger flows of goods via automatically driven freight taxis and trucks as well as highly automated container transports via train.

Despite some restrictions, drones have been allowed for normal goods transport. Their deployment is continuously monitored and takes place exclusively at very low altitudes. Along with urban areas, drones prove to

be a godsend for those underdeveloped regions not well connected to this infrastructure. Drones travel between goods hubs, where deliveries are handed over to local distribution chains, or are delivered directly to the target address using delivery drones. The target addresses have rollout markers and fold-out balcony markers to assist with orientation and landing. Drones in particular have taken over time-critical deliveries, while the non-time-critical deliveries have been taken over by (partly) autonomous vehicles and prosumers.

These concepts have been tested since 2015 and further refined and developed. Changes to the framework conditions, particularly in metropolises, meant that these concepts could be technically, organisationally, and economically realised.



THE FREQUENCY AND AMOUNT OF ELECTRONICALLY SUPPORTED ORDERING AND GOODS DELIVERY PROCESSES DRASTICALLY INCREASES.  
IN METROPOLISES, SHORT-TERM DELIVERY IS THE STANDARD.  
IN PERIPHERAL AREAS, CONSUMERS DON'T BENEFIT FROM THE NEW LOGISTICS SERVICES. AT THE SAME TIME, TRAFFIC VOLUMES HAVE BECOME ALMOST UNMANAGEABLE.

# PROBLEM



### Evaluation of the Future Concept

The continuing growth of online retail increases the pressure for innovation in goods transport and delivery so that conspicuous changes are expected in this sector by 2025. What speaks against this concept's realisation is the variety of approaches to solving the issue. Moreover, the occupancy rates of current modes of transports should first be increased before thinking about establishing new transport modes.



### Feasibility of the Future Concept

As soon as autonomous modes of transport have become a reality, integrated city logistics systems will emerge. Larger organisational and possibly also structural modifications will be required to integrate local public transport systems into urban distribution logistics. The driving forces for the necessary investments could be the internalisation of the social costs of today's goods distribution transport. To take full effect, mileage-based tolls and emissions-free requirements may not be enough. New cooperations must be established at the interface between local public transport and private city logistics, and the coordination problems at these interfaces will be challenging.

# 9

## GOODS TRANSPORT in radical TRANSFORMATION



*»There is a RACE going on between autonomous driving and the use of drones for local goods distribution.«*

▲  EXPERT



All signs point to traffic congestion – independent of the traffic statistics used to project into the future. In the coming years, streets and rails will be subject to greater added strain due to increasing traffic loads, not just supra-regionally but regionally, particularly in metropolitan areas. Despite declining populations and the expansion of transport infrastructures in Germany, the pressure on these infrastructures in metropolitan areas will increase due to urbanisation.

The trend for private cars remains unbroken. At the same time, the wide availability of affordable car-sharing offerings, orderable over the internet, make it possible for a growing portion of the populace to have easy access to individual motorised mobility – at any time and in any place. **A temporary car is literally just an app away, such that increasing numbers of people are offered the possibility of fulfilling their desire for individual mobility.** Subsequently, in combination with ongoing economic growth reflected in the increase in business travel, not only have the number of trips taken increased, but also the length of the distances travelled.<sup>5</sup>



»Food delivery services, which are still a niche phenomenon in this country, will spread and transform today's car traffic for grocery shopping into goods transport.«



Analogous to personal transport, the development of transport volumes for goods knows only one direction: upwards. Goods transport has increased immensely due to increasingly networked, cross-company value creation processes, the attractiveness of online shopping for consumers, same-day delivery, and one-hour delivery even into the night. All goods without an experiential character for purchasing are ordered online, or even completely automatically through a personal, autonomous purchasing agent, and delivered just in time. Selection pressure on intra-urban retail continues to grow, and the trend towards flagship stores intensifies. At the same time, only a fraction of the transport modes are actually used to capacity. **Convenience continues to prevail; driving alone in a car to work is still usual. Apart from that, insufficient networking between transport modes and a lack of incentive systems prevent better utilisation of available transport capacities.** A large portion of the available transport volumes in road-bound lorries remains unexploited. It is estimated that about one-fifth of short-distance trips taken for goods transport occurs with those modes completely empty.<sup>5</sup> The actual number of trips that take place using only partial capacity is likely far more than this.

In the future, rail transport will absorb part of this additional goods transport. Innovative concepts are being researched in this area to better use or even expand the available transport space, for instance through the use of autonomous railway vehicles on regional rail lines ready to be decommissioned. Innovations in road-bound goods transport will increase competition between goods and personal transport for the available transport infrastructure. Platooning concepts, the virtual drawbar for lorries, autonomous driving to combat the skills shortage in the transport sector, electrification for trolley lorries, and approval for sections of the road networks for gigaliners can lower transport costs and thereby increase the attractiveness of road transport.

**Resolving the competition for dwindling transport space requires combining a variety of approaches. Diverse urban logistics concepts are currently being tested, implemented, or have become part of regular operations in selected cities.** The future concepts are focused

on a combination of varying transport modes in urban goods delivery, such as the City2Share project, and the establishment and operation of micro-depots in connection with electric freight bicycles for fine distribution, which are currently being tested in select neighbourhoods in Munich and Hamburg. Individual European cities, including Ghent and Leuven in Belgium, have set up inner-city consolidation centres where deliveries from various suppliers to one customer are consolidated and then delivered by one supplier.

<sup>5</sup> Verkehrsverflechtungsprognose 2030 (2030 traffic integration forecast – in German), German Federal Ministry of Transport and Digital Infrastructure

<sup>6</sup> Prokop; Stoller: Der Güterverkehr von morgen – LKWs zwischen Transporteffizienz und Sicherheit (tomorrow's goods transport – lorries between transport efficiency and safety – in German), Heinrich Böll Foundation, Berlin, 2013

# 9.1

## CHALLENGES



### New Goods Transport Concepts in Combination with Local Public Transport

In order to handle the growth in urban goods transport, it's necessary to think about logistics. The integration of urban local public transport will play a central role by blurring the boundaries between personal transport and goods transport, or possibly even completely eliminating those boundaries. **Transmodal integration of transport modes – which has been much discussed, and realised as part of individual mobility – will by itself not be enough.** Initial approaches to combine the transport modes of both areas being tested today include car boots for transporting packages or the use of private citizens with their cars as delivery drivers for parcel consignments. Due to the short supply of transport areas in metropolitan areas, public structures that were previously dedicated solely to logistics for people could expand their role to function as intermodal hubs for combined urban logistics for people and goods. Innovative concepts for intra-urban goods distributions could be realised using the infrastructure for local public transport and train stations, and car parks. Special park-and-ride facilities at the interface between urban and rural areas could be expanded into goods transshipment points. In the future, delivery robots can handle linking the intra-urban distribution infrastructure realised by local public transport with goods transshipment points at the urban periphery, and neighbourhood delivery between local public transport and delivery locations. Supplying urban peripheries from the goods transshipment points can be realised with the assistance of drones.

**Vis-à-vis pure transport of goods by means of road-bound transport, the use of local public transport infrastructure offers various benefits. Street traffic will be reduced because a portion of goods transports in the inner-city area will take place below ground, or above ground on rails.**

Subways and city trains play a crucial role in intra-urban goods transport due to their short cycle times and high travelling speeds. An important point is the synergies between the two systems. Peak times in passenger transport can be compensated for by greater flexibility and/or time tolerances for goods delivery. Furthermore, future mobility services – similarly to air traffic – envisage the transport of smaller goods to optimise the system's returns.

Instead of building additional tunnels and deploying dedicated trains for goods transport, additional freight cars that land outside of the dedicated platform area when a train stops in a station could be attached at the front or back of passenger trains. For loading and unloading these freight cars, physically separated loading zones could be established adjoining the platform that would allow fully automatic cargo handling of the goods between various trains and modes of transport waiting on the surface. Alternatively, the passenger compartments could be re-designed so that they could be used both to transport passengers and goods, the latter of which would occur with autonomous delivery robots.

The necessary technologies to allow individual goods consignments to communicate with transport modes via wireless communication so that the goods can autonomously seek out the fastest and cheapest path to their destination already exist.

Goods distribution through a local public passenger and goods transport (PPGT), at least in intra-urban areas, offers the greatest benefits for small distances between the delivery location and the nearest PPGT station – delivery of goods directly to the target address isn't necessary in the majority of cases. Heavy or bulky shipments can be transported with small autonomous or manually operated porter units.

Projects such as CarGoTram in Dresden, GüterBim in Vienna, and Cargo-Tram in Zurich show that relevant concepts can be implemented with today's technology. What's more, a study by the New York State Energy Research and Development Authority from 2014 delivers proof of the feasibility of integrating public, rail-bound modes of transport into urban, transmodal goods transport.<sup>7</sup> Autonomous vehicles or delivery robots can be integrated into this urban logistics concept as soon as the technologies are mature and licensed. Furthermore, additional space for logistics infrastructure will not be needed above ground, or only to a small extent.



## Multifunctional Train Stations and Car Parks

Analogous to combining the transport of passengers and goods through a PPGT, additional existing infrastructures geared solely to passenger transport can be functionally expanded. Car parks at the periphery of urban areas, park-and-ride facilities in particular, could be expanded into distribution

»Potential opposition from society, particularly in urban spaces, speaks against the large-scale use of drones for (goods) delivery.«



and transshipment centres for freight logistics. Local public transport can be integrated into freight logistics through these centres due to their proximity to the networks of public modes of transport. These infrastructures can be used as physical platforms for establishing horizontal and vertical cooperative models between logistics services providers. Delivery traffic can be reduced by setting up package stations and through delivery in car boots, with commuters picking up packages on their way to or from work. Private citizens could pick up and transport less time-critical deliveries from the transshipment centres using intelligent, crowd-based delivery concepts designed especially for the urban periphery. This further requires measures to prevent additional traffic due to private trips to package stations.

In addition to establishing distribution and transshipment centres at car parks, train stations could become intra-urban goods distribution points. The city of Paris, for instance, worked with partners to develop the concept of the "logistics hotel", which connects transmodal goods transport over rails and streets. By bundling shipments from different suppliers for fine distribution in advance (in the sense of cargo consolidation), goods traffic heading to the city periphery and into the city could be reduced.

<sup>7</sup> Woodburn; Browne; Allen (2015): Urban Railway Hub Freight Expansion Feasibility Study, University of Westminster, London

## WHEN AND HOW WILL GOODS SEEK OUT THEIR OWN ROUTES AND MEANS OF TRANSPORT: LOGISTICS 4.0?

→ *Competition exists between autonomous driving and the use of drones for goods delivery. The use of many drones could anger the populace. A suggestion to end this competition is that goods will independently seek out their own pathway to recipients using autonomous vehicles in the inner cities and using drones in rural areas. This will be possible as soon as autonomous vehicles are accepted or the use of drones is legal, and makes technical and economic sense. For drones, a critical security issue – regardless of cause – could be enough for trust in this transport mode to be lost. One expert believes that selected package stations in remote areas or commercial customers could be supplied by drones starting in 2017, as soon as the legal framework for automated flying without visual contact is established.*

130  + ADDITIONAL QUESTION FOR THE EXPERTS



### Drones and Delivery Robots for Fine Distribution

The commercial use of drones is currently limited to just a few industries, such as film and television. In the logistics sector, drone technology hasn't yet made it out of the testing phase. Various undertakings demonstrate drones' application potential. The use of drones is promising, particularly for the fine distribution of lighter packages in sparsely populated areas where street-bound transport modes must either drive long distances or a lack of necessary infrastructure hampers conventional delivery.

Expanded infrastructures such as car parks and park-and-ride facilities with goods hubs could serve as the starting point for drone deliveries in the future, as could mobile, street-bound modes of transport. Its greatest potential is currently considered to be in rural areas. With lower population density and longer distances/times per delivery, the economic benefits are larger compared to manual delivery, and finding a space to deliver a package is easier in rural areas than in denser urban environments. Drones could also help in regions with poor street-bound traffic infrastructures, as pilot projects in Africa show.

Innovations in the area of autonomous driving will enable fine distribution in urban areas via smaller and mid-sized pilotless, self-steering modes of transport. However, stronger differentiation is needed between goods transport along medium and long distances, and among modes of transport for delivery in urban areas.

The problem of automatic transshipment requires an integrated logistics chain that factors in the end distribution at the target area while the long-haul vehicle is being loaded. Analogous to package delivery with bicycle couriers, fine distribution in urban areas originating from micro-hubs could be handled by autonomous delivery robots.

Expert Question (498 respondents):

# TRANSPORT AREAS WILL BE CHARACTERISED BY LOGISTICS DEMANDS WHILE PASSENGER MOBILITY NEEDS WILL BECOME SECONDARY.

→ All questioned mobility experts (n = 498); the missing value to 100% = no answer; the proportion of agreement is represented as "Top 2" answers ("Agree completely", "Mostly agree")



Place and time of delivery can be specified to the minute with the help of delivery robots and intelligent networking with the addressee. To increase the radius of action for delivery robots, such autonomous robots could, like human passengers, use local public transport to travel longer distances. This could create higher utilisation of local public transportation, for instance during the night.



70%

↑ OF THE INTERNATIONAL EXPERTS (N = 498) DISAGREED ("BOTTOM 2")

Agreement by **COUNTRY**

10% Germany

12% Europe without Germany

11% USA

Agreement by **INDUSTRY**

11% Mobility

10% ICT\*

11% CS\*\*

15% Education

0%

9/131

GOODS TRANSPORT IN RADICAL TRANSFORMATION

16%

12%

\* Information and communication technology

\*\* Corporate services

# 9.2

## RECOMMENDATIONS FOR ACTION



### ➔ INTELLIGENT LOGISTICS CONCEPTS FOR URBAN AREAS

Comprehensively available, efficient mobility for passengers and goods forms the basis for a region's sustained economic development. To ensure efficient mobility in the future despite the foreseeable increases in traffic, urban areas worldwide must develop logistics concepts that can rise to these challenges. Today's concepts won't do the job. The predominant focus on street-bound modes of transport constricts the solution space and by itself will not lead to the urgently required relief for transport infrastructures. What is needed instead are logistics concepts that rely on consistent networking between all available infrastructures, including local public transport, in combination with new, participative distribution infrastructures and autonomous modes of transport.

To achieve this, the necessary framework conditions must be created through measures in the following areas:

- For infrastructure projects dealing with local public transport, key performance indicators must be defined for efficient passenger transport as well as efficient goods transport.
- Flows of goods must be identified that could be shifted to PPGT and road-bound transport modes connected to it.
- Train stations, local public transportation stops, car parks, and park-and-drive facilities should be assessed for their availability for goods transportation from trains to local public transport or to road-bound modes of transport, both in intra-urban areas and surrounding areas. Relevant zones must be identified as part of development planning (zoning).
- Analogous to street traffic, innovative approaches in railway transport should be encouraged to expand the available transport space.
- Analogous to test tracks for autonomous driving, test sites must be created in urban space for the use of autonomous modes of transport on the streets and in the air.

→ To reduce friction at the transmodal interfaces between private transports and combined private and public transport, horizontal cooperation models must be developed and tested (including in the area of consolidating shipments as well as land use).

→ Politicians must create incentives that promote willingness to cooperate between private logistics services providers – if needed, through the internalisation of external transportation costs.

→ To realise dynamic, transmodal cooperation in urban goods and passenger logistics, traffic information must be gathered and provided in real time to participating stakeholders..

The challenges facing urban areas in particular as regards passenger and goods mobility cannot be tackled with a central solution, but instead must be handled with a combination of various decentralised concepts. Coordinating decentralised concepts requires platforms through which the individual concepts can be merged into integrated, dynamic logistic chains. One example of this is an agent-based transport exchange. Mastering the coordination will necessitate breaking out of dominant models of thinking about current logistics systems. A change of perspective is required: away from the package for which efficient transport must be organised towards the package that autonomously seeks the cheapest or fastest path to its destination. Otherwise the complexity of this decentralised, horizontally and vertically integrated logistics system, will not be manageable. #



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