

Studien zur Mobilitäts- und Verkehrsforschung

Gebhard Wulfhorst

Stefan Klug *Editors*

Sustainable Mobility in Metropolitan Regions

Insights from Interdisciplinary
Research for Practice Application



Springer VS

Studien zur Mobilitäts- und Verkehrsforschung

Herausgegeben von

Matthias Gather, Erfurt

Andreas Kagermeier, Trier

Sven Kesselring, Geislingen

Martin Lanzendorf, Frankfurt am Main

Barbara Lenz, Berlin

Mathias Wilde, Frankfurt am Main

Mobilität ist ein Basisprinzip moderner Gesellschaften; daher ist die Gestaltung von Mobilität im Spannungsfeld von ökonomischen, sozialen und ökologischen Interessen eine zentrale Herausforderung für ihre Institutionen und Mitglieder. Die Schriftenreihe Studien zur Mobilitäts- und Verkehrsforschung versteht sich als gemeinsame Publikationsplattform für neues Wissen aus der Verkehrs- und Mobilitätsforschung. Sie fördert ausdrücklich interdisziplinäres Arbeiten der Sozial-, Politik-, Wirtschafts-, Raum-, Umwelt- und Ingenieurwissenschaften. Das Spektrum der Reihe umfasst Analysen von Mobilitäts- und Verkehrshandeln; Beiträge zur theoretischen und methodischen Weiterentwicklung; zu Nachhaltigkeit und Folgenabschätzungen von Verkehr; Mobilitäts- und Verkehrspolitik, Mobilitätsmanagement und Interventionsstrategien; Güterverkehr und Logistik.

Herausgegeben von

Prof. Dr. Matthias Gather
Verkehrspolitik und Raumplanung
Fachhochschule Erfurt

Prof. Dr. Martin Lanzendorf
Institut für Humangeographie
Goethe Universität Frankfurt am Main

Prof. Dr. Andreas Kagermeier
Freizeit- und Tourismusgeographie
Universität Trier

Prof. Dr. Barbara Lenz
Institut für Verkehrsforschung
Deutsches Zentrum für Luft - und
Raumfahrt (DLR) Berlin

Prof. Dr. Sven Kesselring
Professur für Automobilwirtschaft:
Nachhaltige Mobilität
Hochschule für Wirtschaft und Umwelt,
Geislingen

Dr. Mathias Wilde
Institut für Humangeographie
Goethe Universität Frankfurt am Main

Gebhard Wulfhorst · Stefan Klug
(Eds.)

Sustainable Mobility in Metropolitan Regions

Insights from Interdisciplinary
Research for Practice Application

 Springer VS

Editors

Gebhard Wulfhorst
Munich, Germany

Stefan Klug
Munich, Germany

ISBN 978-3-658-14427-2

ISBN 978-3-658-14428-9 (eBook)

DOI 10.1007/978-3-658-14428-9

Library of Congress Control Number: 2016944487

Springer VS

© Springer Fachmedien Wiesbaden 2016

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made.

Lektorat: Cori Mackrodt, Monika Mülhausen

Printed on acid-free paper

This Springer VS imprint is published by Springer Nature

The registered company is Springer Fachmedien Wiesbaden GmbH

Sustainable Mobility in Metropolitan Regions – Insights from interdisciplinary research for practice applications

Preface

Gebhard Wulforth and Stefan Klug

The contributions of this book are selected outcomes from an international group of young scientists researching in the field of sustainable mobility in metropolitan regions. The scientists belong to the mobil.LAB Doctoral Research Group “Sustainable Mobility in the Metropolitan Region of Munich”, co-funded by the Hans-Böckler-Stiftung (HBS) and hosted at Technische Universität München (TUM) in its first phase from 2011 to 2015.

The research is based on individual case studies from the metropolitan region of Munich. The studies focus on different aspects of sustainable mobility from different disciplines, at different spatial scales, using different methods. They contain on-the-ground solutions and ways of improving the process and transition to sustainability. Each of the contributions includes multiple insights of theoretical knowledge, methods used to assess sustainable mobility, the way how to study and how to conceptualize sustainable development. However, the scope of the chapters differs according to the state of the research.

Moreover, a common understanding of sustainable mobility in metropolitan regions has been developed as a framework within the research group. Each contribution acts within this framework but specifies the definition within a certain context. In consequence, the knowledge and experiences from the interdisciplinary research network are shared in order to generate strategies and actions to address, promote and support sustainable mobility in metropolitan regions. The book therefore is orientated toward the practice level. It should help to put the ideas on the table and inspire the debate about sustainable development in general and options of future mobility solutions in particular.

The **introduction** to this book highlights some framing aspects of one common topic: “Sustainable mobility in the metropolitan region of Munich”. In the following parts of the book, the key findings of young scientists from various disciplines are presented.

The first part of the book is dedicated to **innovative policy approaches** for sustainable mobility. When speaking of sustainable mobility the spatial dimension is crucial. The locations of different land use, such as housing, shopping, employment and leisure have huge impact on mobility behavior. When properly estimating the environmental effects of the built environment also induced impacts on transport need to be considered. John E. Anderson suggests an expanded life cycle approach, which involves the assessment of the interactions between the building scale and the urban scale. For the region of Munich the method illustrates that induced impacts constitute approximately 50% of all impacts of the built environment. In the latter part of the chapter Anderson suggests recommendations to the diverse stakeholders and actors on their particular role in the incorporation of the induced impacts. Stakeholders are also a central element of the contribution by Chelsea Tschöerner who highlights the term of 'sustainable mobility' from the governance perspective. The concept does have different meanings depending on the procedure of communication. By doing interviews and analyzing historic media she shed light on the production, reproduction and transformation of the concept in everyday politics and policy-making on a municipal level. The case of Munich is used to develop a more general understanding, which can be applied to other metropolitan regions.

The second part of this book focuses on **specific target groups**. Leisure activities generate by far the most trips and account for about one third of all trips being made. Therefore it is important to evaluate how this aspect of mobility can become more sustainable. Diem-Trinh Le-Klähn investigated a case study of tourists' use of public transport in the region of Munich. She elaborates policy implications for both transport and tourism management and suggests marketing strategies, which can be also transferred to other cities of similar conditions. Another segment of mobility is the subject of the contribution by Katrin Roller. She focuses on corporate mobility under the aspect of its social impact. The working world is very closely linked to the need of mobility. Additionally to the need of daily commuting often business trips are required from employees. When and by what does this become a burden? The author specifies the factors that strengthen and those, which limit stresses and strains of commuting, business travel and the need to change between several work places. The interrelation of housing and mobility is the subject of latter two contributions of this part. Based on the recently completed research project "Residence, Work and Mobility (WAM)" carried out by a research group of Technische Universität München, two specific cases are considered. Lena Sterzer discusses the interrelations between residential location, mobility and mobility-related discrimination with a particular focus on low-income groups. Low-income groups are very much affected by high real estate prices so that they have to compromise not only on quality of their residence but on its location. This can have far-reaching

consequences on their mobility behavior. On the other hand, also other milieus have certain requirements on housing and mobility options. Juanjuan Zhao focuses on the knowledge-based workers' interdependent choices regarding residential location, workplace and mobility.

The third part deals with individual **options of change** towards sustainable mobility.

Benjamin Büttner suggests new local and regional development strategies in function of mobility costs. Based on a GIS-based vulnerability assessment he analyzed the potential and risk of specific locations within the region of Munich towards a sharp increase in mobility costs. Accessibility indicators are set up and used to estimate the resilience of residential locations. Potential solutions on the individual level as well as strategies and measures on the level of public authorities to prepare for future scenarios of mobility costs are presented.

As a matter of fact, the most sustainable modes are walking and cycling. Both modes show very low environmental impacts, are less costly from the individual's perspective than driving and do have positive social impacts, such as individual well-being and public health. One important concept to foster the use of bicycles and improve the environment for pedestrians is neighborhood mobility – but how to assess the improved conditions of walking and cycling? Matthew B. Okrah puts his focus on the macroscopic four step travel demand modelling which is often the base for local transport planning. Due to the size of the transport zones, trips by bike and on foot often start and end in the same zone. Therefore these trips have been neglected for a long time in classical modelling. Taking in account soft modes on an appropriate level will give perspectives for a new generation of urban travel demand modelling.

However, when considering walking and cycling as a chance to make mobility more sustainable, also technological innovations have to be taken into account. Recently the electrification of vehicles became a major issue, not only because of the technological progress, but also because of the rising oil prices and the risks of fossil fuel as a finite resource. While the public focus is on electric cars, a real boom can be found for electrically driven or supported bicycles (pedelecs). The main advantage is an extension of the usage possibilities and therefore of mobility options. However, the acceptance of electric vehicles depends very much on individual mobility perceptions, which is the focus of Jessica Le Bris' contribution. She did in-depths investigations of adaptation and use of pedelecs and her analysis confirms the hypothesis, that pedelecs are a serious mobility option for local, regional and active mobility and a wide range of different social groups. She derives general promotion strategies about the acceptance of electric bicycles.

In the last part of the book, two chapters intend to draw **conclusions** and give an **outlook** on future perspectives. Stefan Klug, together with Julia Kinigadner and Montserrat Miramontes, two additional doctoral candidates associated to the mobil.LAB research group, give a review and synthesis of the individual contributions, regarding the common objective of sustainable mobility in metropolitan regions. Basically, the insights from interdisciplinary research discussed in this book show that for implementation in practice, the cooperation of multiple stakeholders is key.

In this perspective, the mobil.LAB doctoral research group will continue to act as an open lab, involving not only young researches and senior scientists but also practice partners, such as public authorities on the local and regional level, private firms and decision makers, and the civic society. Gebhard Wulffhorst and Sven Kesselring give their perspectives on future activities in the field of sustainable mobility in metropolitan regions, targeting the focus of “shaping mobility cultures” – as an outlook on the upcoming phase of the research group.

Sustainable development of mobility in metropolitan regions is an ongoing and complex process. This book can only be a piece of the puzzle, providing some insights based on scientific observation, experience and analyses. It may help to provide some useful orientations to the practice level – far beyond the metropolitan region of Munich.

It's up to you to make a change.

We are very grateful that this project of publishing selected results of the individual research studies in one common book has become a reality. This book is a product of many people.

We therefore owe our respect first of all to the Hans-Böckler-Stiftung, generously supporting all the work being done – not only by the financial support of the fellowships and the program, but also based upon the personal relationships, namely with Werner Fiedler and Dr. Gudrun Löhner.

The quality of the book has been highly enhanced by the fruitful feedback provided by reviewers who were officially integrated into the process from science and practice. Each of the chapters in general got comments from two reviews from both fields. We want to thank André Bruns (Frankfurt), Roman Frick (Zurich), Markus Friedrich (Stuttgart), Regine Gerike (Dresden), Karst Geurs (Enschede), Anette Haas (Nuremberg), Sven Kesselring (Geislingen), Georg-Friedrich Koppen (Munich), Hartmut Krietemeyer (Munich), Manfred Neun (Brussels), Werner Nüßle (Munich), Hiltraut Paridon (Dresden), Malene Freudendal-Pedersen (Roskilde), Johannes Schlaich (Karlsruhe), André Stephan (Bruxelles), Oliver Schwedes (Berlin), Stephan Schott (Munich), Stefan Siedentop (Dortmund), Claus Tully (Munich) and Marc Wissmann (Munich). You did a great job. We hope you like the result.

We are grateful as well to the editors of the series of this book for their support in accepting our manuscript, to Carina Ruppert and André Prescher for their help in editing the contributions, to Enago for the English proofreading service and to Springer VS for all layout and publishing efforts.

Last but not least, we want to express our thanks to all the authors for their ineffable commitment. You will be rewarded!

Munich, 21st March 2016

The editors

Gebhard Wulforth, Stefan Klug

Contents

Preface V
Gebhard Wulforth and Stefan Klug

Abbreviations XIII

Sustainable Mobility in the Metropolitan Region of Munich:
An Introduction 1
Gebhard Wulforth and Stefan Klug

Part I Innovative Policy Approaches

A Governance Approach to Sustainable Mobility 19
Chelsea Tschoerner

Policies to Achieve Environmental Goals in the Built Environment 33
John E. Anderson

Part II Specific Target Groups

Sustainable Tourist Mobility: Implications for Urban Destination
Management 55
Diem-Trinh Le-Klähn

Corporate Mobility: When and Why Does it Become a Burden?	65
<i>Katrin Roller</i>	
Social Sustainability and Mobility: The Case of Low-Income Groups	83
<i>Lena Sterzer</i>	
'Knowledge-Workers': A Conceptual Framework on Commuting Patterns ..	99
<i>Juanjuan Zhao, Michael Bentlage and Alain Thierstein</i>	

Part III Options of Change

Sharp Increases in Mobility Costs: A Trigger for Sustainable Mobility	125
<i>Benjamin Büttner</i>	
Handling Non-Motorized Trips in Travel Demand Models	155
<i>Matthew Bediako Okrah</i>	
Pedelecs as New Tools for Active Mobility: 'Cheating' or Sustainable Transportation?	173
<i>Jessica Le Bris</i>	

Part IV Conclusions and Outlook

Individual Contributions Toward a Common Objective	191
<i>Stefan Klug, Julia Kinigadner and Montserrat Miramontes</i>	
Perspectives on Sustainable Mobility in Metropolitan Regions: Shaping Mobility Cultures	201
<i>Sven Kesselring and Gebhard Wulfhorst</i>	
Contributors	223

Abbreviations

BMW	Bayerische Motorenwerke
CO ₂ e	carbon dioxide equivalent
EMM (e.V.)	European Metropolitan Region of Munich (association body)
GHG	greenhouse gas
Gt	metric gigaton
HBS	Hans-Böckler-Stiftung (Hans Böckler Foundation)
HCT	Human capital theory
IAA	Internationale Automobilausstellung (Frankfurt Motor Show)
IMU	Institute of Media Research and Urbanism
LEED	Leadership in Energy and Environmental Design
MiD	Mobilität in Deutschland (Germany's national travel survey)
MVV	Münchner Verkehrs- und Tarifverbund (Munich Transport and Tariff Association)
MVG	Münchner Verkehrsgesellschaft (Munich Transportation Corporation)
P+R	Park and Ride
Ph. D.	Philosophy Doctor
ppmv	parts per million by volume
PrT	Private Motorized Transport
PuT	Public Transport
R&D	Research & Development
SCOT	Schema de Cohérence Territoriale (French planning document for metropolitan regions)
t	metric ton
TAZs	traffic analysis zones
TUM	Technische Universität München (Technical University of Munich)
VKTs	vehicle kilometers traveled

Sustainable Mobility in the Metropolitan Region of Munich: An Introduction

Gebhard Wulforth and Stefan Klug

This book, *Sustainable Mobility in Metropolitan Regions* is the product of the first four years of collaborative work by the mobil.LAB doctoral research group, an “impact hub” within a larger research network (cf. Wulforth et al. 2014). It brings together multiple studies on aspects of sustainable mobility in the metropolitan region of Munich, which we have used as our reference case.

We hope to contribute to fruitful exchange between researchers and practitioners in various disciplines. This book is based on insights from many sources: interdisciplinary research, quantitative and qualitative observations, scientific analyses, varying perspectives, individual experiences, and common learning. We seek to provide practical insights that will support improved orientation, explain multiple interactions and feedback, contribute to policy choices and decisions, and provide useful direction in a complex world. We look forward to hearing from readers as to whether they find our work to be on the right track.

How do we understand and conceptualize sustainable mobility in metropolitan regions? In this introductory chapter, we begin by mentioning each of the key terms contained in the book title, to draw a comprehensive picture and set up a framework for the individual contributions.

1 Sustainable Development

Recognizing sustainability as literally the *ability to sustain*, we see that two perspectives must be interlinked. From a bottom-up perspective, at the individual level, we have an intrinsic motivation to stay alive and healthy—to survive. From a top-down perspective, at the system level, we urgently need to develop a common understanding of how to sustain the whole system, so that the sum of everyone’s

individual actions does not undermine it. Therefore, if we want to survive as a global society, we have to work on sustainable development.

“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” This is how the Brundtland Commission (WCED 1987) defines the term, with a central focus on the essential needs of the poor and the limits of growth (cf. Meadows et al. 1972). The concept originates in the knowledge base and experience of forestry management (cf. von Carlowitz 1713).

In this sense, the concept of sustainable development is not a choice, and there is no need to discuss whether we support it. What we do need to discuss and agree upon, probably over and over again in every region and every generation, is what we consider relevant for the sustainability of our system, our planet, our society, our mobility. How do we define sustainable development at a normative system level, in the long run? How do we implement the process in our daily decisions, at an individual level, in day-to-day practice? And finally, as probably one of the most important aspects of this whole discussion, how do we create the necessary link between our individual decisions and effects on the system?

Often, we fail to take system effects into account in our individual behavior because we ignore the dynamic feedback that might involve more time or more complex mechanisms than we are able to consider. In consequence, what we urgently need is a framework of understanding and regulatory conditions that help us to develop collective wisdom for integrating intrinsic economic motivations, social welfare, and environmental boundaries into each and every decision.

Individual benefits and shared values are relevant building blocks of this framework. Rather than balancing between the different dimensions of sustainable development—often referred to as economic, social, and environmental dimensions (cf. WCED 1987; Hardi, Barg 1997; Dresner 2002), we follow orientations that are based on an interwoven system:

- Economic aspects include individual return on investment and profitability. It must make sense, from an individual perspective, to make an effort to select sustainable choices. Factors on the system level, such as incentives, restrictions, economic regulations, and taxes, must guide our decisions in sustainable ways.
- Social aspects refer to the ways in which German and other Western societies have learned to frame economic decisions from a social-welfare perspective, according to whether they contribute to conditions of societal prosperity.
- Environmental aspects set clear, non-negotiable boundary conditions regarding how we treat our ecosystem. The thresholds of this system have to be respected. We must translate these environmental conditions—from global climate change

to local noise pollution—into market conditions that enable people’s health and well-being.

Figure 1 highlights this understanding by showing an inclusive approach that contains all three layers within one system.

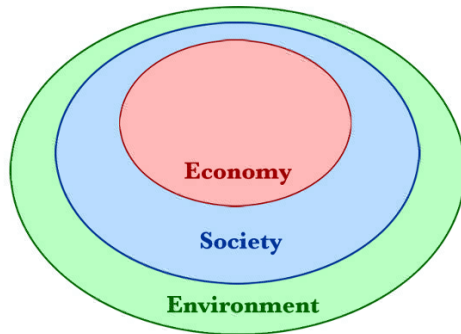


Fig. 1 Sustainability as a concept of three concentric circles (Helleman 2012)

As the figure illustrates, the environment establishes the boundaries for our development; the society and the economy evolve within it (SRU 2002; Weber-Blaschke 2009; Weber-Blaschke et al. 2004). This idea is slightly different from the so-called triple bottom line introduced by John Elkington in 1994. The triple bottom line is an accounting framework with three different and quite separate divisions (social, environmental, and financial), also referred to as the “three P’s” – people, planet, and profit (cf. Slaper, Hall 2011).

We have consciously chosen to give a priority and hierarchy to the three dimensions, preferring this construct to a balanced trade-off between the dimensions, as there is no economy without society and no society without a habitable environment.

Considering the transport sector, Gerike (2005) has argued for giving a (normative) framework to market allocation processes that help to overcome the “imperfections” of a free market. The upper and lower borders of a social task field and a resource task field, as shown in Figure 2, guide the development of a framework suitable for governing the market allocation task.

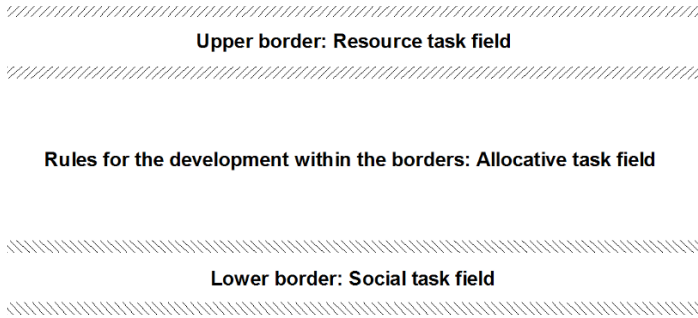


Fig. 2 Development corridor for sustainable transport development (Gerike 2005, p 11)

However, this understanding should not lead us to view sustainable development as conservative, or as implying a total or virtual freeze on new development. On the contrary, the concept inherently assumes change, adaptation, and dynamic processes that take place within the framing conditions and our understanding of them. Sustainable development takes into account past trends and the current and expected future situation of the framework, including such factors as environmental conditions, technological innovation, and social change. We will have to remain reflexive, reactive, active, and creative in order to seek appropriate solutions to each specific challenge.

Sustainable development is an ongoing, open process of mutual understanding and common learning, which also includes experimental implementation and evaluation (cf. Wulfhorst et al. 2013; Gerike et al. 2013; Witzgall et al. 2013).

2 Mobility

The system that we are looking at is the mobility system in metropolitan regions. Mobility takes the individual perspective. We understand mobility, first and foremost, as the ability to move (cf. Chandler et al. 1990, Hansen 1959, Handy 1994). In this way, it has intrinsic value and is a driver of change. It is considered to be a movement imbued with meaning (cf. Adey 2010, Cresswell 2006), corresponding to a given purpose.

Mobility enables us to perform activities at different locations, to participate in social, economic, and cultural exchange, to discover, to learn, to experience something new, and (hopefully) to achieve long-term objectives.

There are different types of mobility:

- Social mobility (i.e., one's ability to change one's position within a social system, based on such factors as education, employment opportunities, and household or family composition), which can be reflected by status symbols like a fancy car or other related values, preferences, habits, and routines of lifestyle and social context.
- Long-term spatial mobility decisions (such as choices of residential or workplace location, intentional migration, or forced displacement).
- Medium-range mobility decisions (such as car ownership, car sharing membership, purchase of a public transport pass, or getting a new bicycle).
- Everyday physical mobility decisions (i.e., choice of travel mode, destinations, and routes for daily trips).
- Virtual mobility, or new mobility options driven by technological innovations (such as "mobile communication" and related information and communication technologies).

Given this range of meanings, some social scientists refer to *mobilities* as an inclusive social concept covering these diverse layers and the variety of motivations for, conditions of, and expressions of mobility (cf. Canzler et al. 2008, Urry 2007, Witzgall et al. 2013).

Based on this understanding, we start our research with the classical concern for short-term, physical mobility behavior (from the transport planning perspective, basically measuring mobility in terms of the number of trips, taking into account the diversity of activities at different locations and the respective trip purposes). We then open up our reflection and discussion to multiple disciplinary perspectives on the phenomenon – including diverse terms such as *mobility practice*, *discourse*, and *arenas of mobility*, as well as the various related policy dimensions.

As a starting point for our research program, we intended to focus on the following distinct aspects of transportation (cf. Figure 3):

- Transport system: What options are provided by the land-use and transport system (accessibility)?
- Transport behavior: How are those options being used, and what are the benefits for the individual user (behavioral research)?
- Transport culture: What are the reasons behind the behavior, and what needs are being satisfied?
- Transport policy: How can the system be assessed and evaluated, and what recommendations can be given to improve sustainability performance at the level of a metropolitan region?

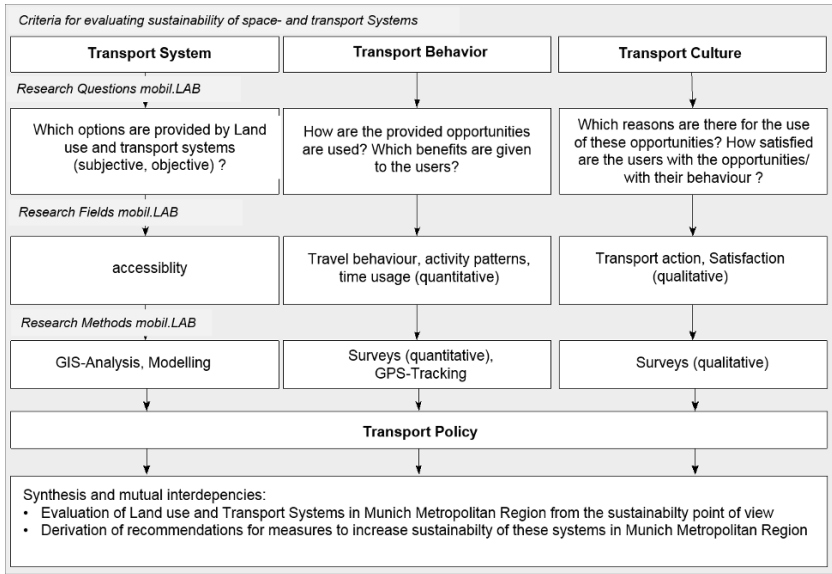


Fig. 3 Topic areas addressed within the first phase of the doctoral research program

We will see that we need to develop a more comprehensive understanding, taking into account not only mobility behavior but also the conditions of spatial structure and transport supply, the impact of cultural preferences and lifestyle orientations, and policy-making and governance processes. In this book, we will further develop this approach to the extent of considering a *mobility culture* (cf. outlook by Wulforth and Kesselring in Part IV: Conclusions and Outlook).

Transport (or *transportation*) at the system level enables *traffic*, which is the observable phenomena of items—such as vehicles, people, or data bits—moving around in the transportation network. Transport is the collective result, a derived demand of realized individual mobility decisions in the long term (household context, location choice, car ownership, etc.) and in the short term (number of trips, modes, destinations). It is the physical exchange of persons, goods, and information between different places (cf. Pirath 1949).

Transportation is a critical segment of sustainable development for the following reasons:

- It is a constitutional element within our economic system (not only because of the need to transport people and goods so that they can participate in a market, but also because of the huge importance and impact of related industries and energy markets).
- It creates, by its very nature, social equities and inequities (related to network configuration, access conditions, costs, and impacts on social inclusion or exclusion).
- It produces environmental damage (such as noise, air pollution, fine particles, land cover change, and CO₂ emissions).

To highlight just one of the many crucial points of debate, the transportation sector is responsible for about one-fourth of all CO₂ emissions on a global scale (cf. ITF 2010). Often the related embodied greenhouse gas (GHG) emissions that we should include in a life-cycle approach are not even considered (e.g., for vehicle materials and manufacturing, or embodied energy and emissions in transport infrastructure). With many sectors (housing, energy, industry) introducing successful climate change mitigation strategies, the impact of the transportation sector could grow still further in relative as well as absolute figures. Despite many achievements in efficiency due to regulation and technology (such as reductions in CO₂ emissions per kilometer of vehicle travel), overall GHG emissions from transportation have increased substantially since 1990. The efficiencies are partly counteracted by the upsurge in larger vehicles with additional features such as air conditioning. The more important effects, however, are generated by several system factors:

- more trips (an increase in overall mobility, driven on a global scale by population growth and economic interaction);
- higher motorization (more access to cars, motorcycles, buses, and airplanes);
- more car traffic (associated with reduced shares of walking, cycling, and public transport use on a global level);
- low occupation rates (related to considerable inefficiencies in private, public, freight, and passenger transport, including a growing tendency to drive alone); and
- longer trips (a continuous increase in distances covered, at higher speeds, within an expanding system of global travel).

Therefore, some people say that today's transportation is unsustainable. Perhaps it will not be sustainable tomorrow. We certainly need more sustainable mobility (cf. Banister 2008), but there is much more to address than the idiomatic logics of *avoid*, *shift*, and *improve*.

In the developed world, many challenges have been addressed and tackled on the local level. We have seen progress in traffic safety with the general introduc-

tion of seat belts and increasing airbag configurations – at least for the car driver and passengers, although issues related to the safety of cyclists and pedestrians, especially the elderly, remain. Most local air pollutants (SO_2 , CO, NO_2 , PM_{10} , $\text{PM}_{2.5}$, PAH) have been significantly reduced with the broad implementation of catalysts and specific filters. And technological innovations, such as electric vehicles, might help to address our fossil fuel dependency as well.

The most relevant impact of transport, however, that will remain a key challenge on the local level is the competition for urban space. As this most valuable resource of a city is definitely limited, conflicts are predictable. Congestion and parking problems are a common feature in prosperous and attractive places, and in most cases the solutions to keep these places attractive will not involve providing more space for traffic. Even beyond this narrow consideration, questions of how to address multiple transportation needs and local activities in an urban environment remain some of the most interesting tasks in this field, as they will require designing, negotiating, and balancing case-specific solutions to satisfy multiple stakeholders.

We will not be successful if we limit ourselves to reinventing city-friendly transportation (after having failed with car-oriented cities) – not even with electric cars! We need to understand, explore, and promote the fact that transportation and mobility are foundational for the development of urban places, including both small towns and global cities.

Transportation networks and services provide access to locations, at which specific urban functions emerge. The connection between these different places and activities again relies on transportation. Both urban functions and transportation are integrated within the concept of accessibility, which is a key element of land-use and transport dynamics.

Accessibility describes “the extent to which land-use and transport systems enable (groups of) individuals to reach activities or destinations by means of a (combination of) transport mode(s) (at various times of the day)” (Geurs, van Wee 2004). If we want to provide sustainable mobility, then we have to search for sustainable accessibility (cf. Le Clerq, Bertolini 2003; Wulfhorst 2008). Accessibility does have an influence on the long-term development of the mobility system and, in that way, on the daily choices of travelers.

We can recognize that providing accessibility for different user groups, by sustainable means of transportation and on multiple spatial scales, is a continuous challenge. Accessibility is a powerful concept for sustainable land-use and transport strategies. However, as accessibility is a compound variable made up of different components, we cannot address it directly by planning. We need to refer to either the transportation system or the spatial structure in order to change the key framing conditions. In addition, we need to consider individual abilities to take

advantage of the access provided, as well as the access conditions of specific services in coherence with the activity schedule (e.g., hours of operation).

As we look toward the future, it is worthwhile to consider the impact of uncertainties – for example, changes in transportation or housing costs – on planning philosophies and implementation strategies. Often we will not be able to predict the future reliably, so we will instead have to prepare for various potential scenarios. Moreover, we will have to make sure that the decisions made today will still be effective in these potential contexts. Our planning procedures and decision-making processes should reflect this flexibility, taking into account different projected future scenarios. They should enable adaptive measures, depending on the framing conditions, in order to keep us on track toward sustainable mobility.

Especially in our time, where technological and social innovation are creating a completely new system of mobility (e.g., contributing to the popularity of car sharing and ride sharing), we must remain creative in order to incorporate new opportunities and some critical threats into the task of designing the future (cf. Bertolini 2012). Accessibility instruments can help to support this planning task, starting from problem statements across strategy making, scenario evaluation, and reformulating expected outcomes (cf. Figure 4).

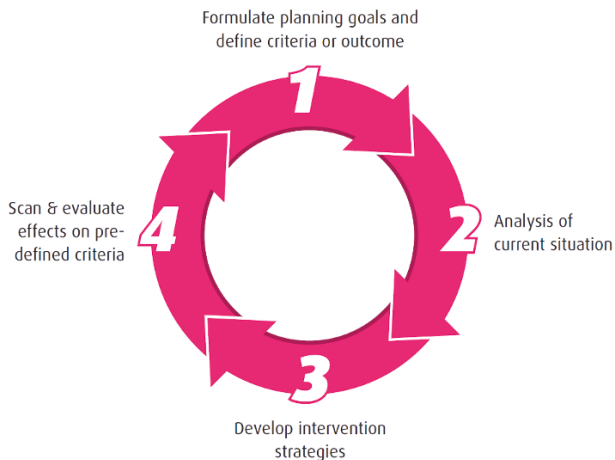


Fig. 4 The planning feedback cycle (cf. te Brömmelstroet et al. 2010)

In that sense, one key to sustainable development of mobility is to preserve options. Some paths into the future, such as car dependence, could turn out to be too high-risk. Probably we need to focus much more on reinvesting in independence. Autonomy or even autarchy will be difficult to achieve, but sufficiency might prove to be a much more important success factor than efficiency.

We have to ensure room and time for the individual fulfillment of needs, from basic needs to love and self-esteem and on to self-actualization and (following Maslow's hierarchy) even beyond to self-transcendence (i.e., altruism and spirituality). Translated to land use and transport, these priorities could well mean valuing our local identity (home) and slow travel – in other words, “slow down and stay”!

3 Metropolitan regions

We have focused our research program on the spatial scale of *metropolitan regions* and more specifically on the metropolitan region of Munich as a reference case. But how do we understand and contextualize this term, which needs a definition and a delimitation?

Perhaps the specific term can be related to a European policy concept. Starting from the *European city*, a classical notion of a community-based, free place of proud citizens, going by the functional terms of the *city region*, as defined by Boustedt (1953) based on commuter flows, the concept of European metropolitan regions has gained importance in discussions dating back to the German spatial planning documents of the 1990s. It has been enlarged as a normative concept within the European Spatial Development Program in 1999 and materialized in Germany's “visions and strategies on spatial development,” as agreed upon by the conference of ministers of spatial planning in 2006 (Aring, Sinz 2006). The concept is supposed to strengthen major German city regions at the international level (BBSR 2011).

The European Metropolitan Region of Munich (EMM e.V.) has been formally founded as a governance cooperation between public and private partners. Situated in the south of Germany, this region occupies close to 40% of the total area of the Free State of Bavaria and is home to almost half of Bavaria's over 12 million inhabitants (see Figure 5). Due to its favorable employment opportunities, the region continues to attract more people each year, contributing to population growth and economic prosperity. Munich, Germany's third-largest city, with about 1.5 million inhabitants, is located in the center of the region. Other secondary cities (such as Augsburg, Ingolstadt, Landshut, Rosenheim, and Kaufbeuren) are linked with Munich and support the outstanding efforts to be competitive on the international stage.