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Smart Mobility in Germany: A Service-Dominant Logic Perspective

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Preface

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Deggingen, 10.06.2021 Thomas Schulz

Abstract

Problem Statement: The private car is the dominant means of transport in most industrialized countries of the world, causing problems such as traffic jams, lack of parking space, as well as air and noise pollution. A key advantage of the private car is that it allows seamless transport from an origin to a destination without requiring transfers, as is often the case using public transport. In the recent past, technological progress and digitalization have made alternative mobility services, such as car- and ride-sharing, more convenient to use, which has contributed to their diffusion. For instance, a smartphone app can be used to arrange a ride instead of waiting at the side of the road with your thumb up. As a result of ongoing digitalization, mobility providers increasingly have a variety of information at their disposal, for example, about the delay or crowding of a bus or the location of car-sharing vehicles in a geographical area, which can be used on an aggregated level to provide recommendations for combining multiple mobility services for a trip from an origin to a destination (defined as smart mobility). To facilitate such joint service provision, different actors (e.g., mobility providers, public authorities, and customers) must form a service ecosystem. In practice, however, a stagnation in the emergence and development of such service ecosystems can be observed during the last years. In order to support their emergence, their function, and to ensure their long-term viability, it is important to establish value co-creation between all relevant actors. However, research in this area is still in its infancy and insufficient to guide the efforts of practitioners.

Research Design: To address this gap, this thesis adopts a mixed methods research design including a literature review, expert interviews, a case study, a qualitative comparative analysis (QCA), and a conjoint analysis. The empirical data collection took place in Germany and focused on various actors, such as mobility providers, public authorities, and (potential) customers. As an overarching analytical lens, this thesis adopts the service-dominant (S-D) logic perspective, which was originally introduced into marketing, but is now well-established in numerous scientific fields, including information systems (IS). On the basis of previous work, it is assumed that the intended shift from the purchase and use of private cars to the sequential use of different mobility services reflects a shift from the goods-dominant (G-D) logic to the S-D logic. Research that adopts the S-D logic perspective is usually centered on one or more of its three main concepts: (1) the service ecosystem, (2) the service platform (e.g. a smartphone app), and (3) value co-creation, which are focused on in various ways in the publications embedded in this thesis.

Main Results: Categorized along the three main concepts of the S-D logic perspective, the main findings of this thesis are: (1) The actors of a service ecosystem are linked by different institutional arrangements (rules, norms, and beliefs). We show how the configuration of a service ecosystem with regard to its actors and its institutional arrangements is linked to the information technology (IT) choice of its actors. In addition, we illustrate how the need for legitimacy and the ability to build up the countervailing power of an actor depend on the institutional arrangements that are present in its service ecosystem. This in turn affects the disposition of an actor to engage and its activity of engaging in value co-creation with actors embedded in other service ecosystems, such as in a service ecosystem of a smart mobility app provider; (2) we

clarify the emerging role of the smart mobility app provider. Initially, we conduct an interdisciplinary literature review to identify the current state of knowledge on the operand (e.g., interfaces, algorithms) and operant resources (its capability to ensure security and privacy, etc.) underlying its value co-creation. Subsequently, we determine the preference structures of potential customers with regard to an app for smart mobility. In the analysis, we identify differences in preference structures depending on the current mobility behavior of potential customers, their age and their place of residence; and (3) we complement the S-D logic perspective, among others, with activity theory (AT), to provide insights into how value co-creation can be initiated and increased between the (potential) actors of a service ecosystem for smart mobility.

Contributions: We make several practical and theoretical contributions: (1) driven by the ongoing digitalization, service ecosystems are currently emerging in a wide variety of industries (e.g., finance, health) focusing on the combination of several services depending on customer needs, but (IS) research on this topic is still very scarce. By considering the three main concepts of the S-D logic perspective (service ecosystem, service platform, and value co-creation), in the context of smart mobility, we contribute to a holistic understanding that supports practitioners to push further the emergence of such service ecosystems, as well as to ensure their functioning and their long-term viability. In the case of smart mobility, this can contribute to reduced private car usage and alleviate problems caused by private car usage; and (2) the S-D logic perspective is on a meta-theoretical level, so many previous studies adopting this perspective are conceptual in nature. We develop the S-D logic perspective towards a midrange theory by complementing it with several theories outside of marketing, such as role conflict theory and AT. Since the S-D logic perspective is very popular in a variety of research fields (e.g., business economics, service science), we provide an enhanced theoretical foundation for future research beyond the IS field.

Limitations: As with all research, this thesis has some limitations. Its two main limitations are: (1) although the S-D logic perspective is established in numerous research fields, there are other perspectives and theories that also deal with the concept of value co-creation. It remains unclear how the explanatory power of the S-D logic perspective compares with these perspectives and theories; and (2) although there are good reasons for conducting data collection in Germany (e.g., pre-existing infrastructure, high public pressure for a shift away from private car usage), this focus limits the generalizability of our results.

Future Research: This thesis yields five starting points for future research: (1) Future research should be conducted with actors from other countries, such as from the United States, to understand the impact of varying institutional arrangements (e.g., welfare versus a more neo-liberal mobility market) on value co-creation; (2) The mobility sector is changing rapidly due to technological progress. In the future, autonomous vehicles will increasingly be used for parts of the trip from an origin to a destination. As a result, much more data (roads condition, weather, etc.) will become available to the actors of service ecosystems for smart mobility than today. However, solutions are needed to deal with the technical complexity, as well as with the issue of data sovereignty and data security; (3) technological progress, such as the development of electric vehicles, leads to a blurring of sector boundaries. In future studies, actors from the energy sector should also be taken into account in order to address the challenges that arise when an electric vehicle is used as a decentralized power plant; (4) we find that value co-creation among the actors of a service ecosystem for smart mobility leads to the generation of a wide variety of values (e.g., economic and societal value). Future research should provide a more nuanced understanding on the different value types; and (5) we assume that an app-supported combination of multiple mobility services will make them more attractive for potential customers and can contribute to the reduction of private car use. Due to the increasing provision of apps for smart mobility on the market, there is an increasing possibility to examine behavioral changes of their customers with long-term studies. In addition, it should be analyzed whether incentives such as dynamic prices, which are well-known from airlines, or seat reservations, can be used to influence the route choice of customers, and thus, of their choice of mobility services.

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List of Abbreviations

AMCIS	Americas Conference on Information Systems
AT	Activity theory
BISE	Business & Information Systems Engineering
CBC	Choice-based conjoint
ECIS	European Conference on Information Systems
EM	Electronic Markets
fsQCA	Fuzzy-set qualitative comparative analysis
G-D	Goods-dominant
GPS	Global positioning system
ICIS	International Conference on Information Systems
IS	Information systems
IT	Information technology
MaaS	Mobility as a service
P	Publication
PACIS	Pacific Asia Conference on Information Systems
QCA	Qualitative comparative analysis
RQ	Research question
S-D	Service-dominant
TCA	Traditional conjoint analysis
VHB	German Academic Association for Business Research
WI	International Conference on Wirtschaftsinformatik

Part A

1 Introduction

The worldwide demand for motor vehicles will not exceed one million
– if only because of the lack of available chauffeurs.

Gottlieb Wilhelm Daimler (Schütt (2015), own translation).

Gottlieb Wilhelm Daimler (1834-1900) is one of the pioneers of automotive engineering. Contrary to his prediction, the motor vehicle has developed into one of the most successful innovations in history that contributes to the private and commercial mobility of well over a billion people worldwide (Statista, 2017). For instance, more than 3.4 million new vehicles were sold alone in Germany in 2018 (Kraftfahrt-Bundesamt, 2020). But the success of the vehicle also has a dark side, including time wasted waiting in traffic, as well as noise and air pollution (Schreieck et al., 2018; Willing et al., 2017a; 2017b). Driven by the societal need to address these problems and by potential solutions provided by technological progress, especially digitalization, the mobility sector is in a state of flux (Münchner Kreis e.V., 2017).

Automotive manufacturers are developing and applying new technologies to produce electric and hybrid vehicles that produce less air and noise pollution, but the required charging infrastructure is still underdeveloped and currently represents an obstacle to their proliferation (Hoerstebrock and Hahn, 2014). Shared services, such as bike-, car-, and ride-sharing (e.g., Firnkorn and Müller, 2011; Shaheen et al., 2009; Teubner and Flath, 2015; Yin et al., 2019), which have gained popularity with the rise of the platform economy, can also contribute to solving problems associated with private car usage. People living in many larger urban areas in highly industrialized countries have access to multiple mobility services (e.g., BlaBlaCar, Lyft, Share Now, and Uber) offered by competing mobility providers as an alternative to buying and using a private car (Willing et al., 2017b).

In this thesis, we aim to understand how the emergence and functioning of service ecosystems consisting of competing and complementary mobility providers can be supported and their long-term viability ensured. Particularly, we focus on the new emerging role of service platform providers around which service ecosystems are organized, and on how customers can use such service platforms (usually smartphone apps) to combine multiple mobility services in an individual, context-aware, and dynamic fashion to get from an origin to a destination (so-called smart mobility).

1.1 Problem Statement

The exponential growth in fixed-line and mobile Internet usage and the emergence of the platform economy have affected almost all industries by changing service and production processes and by destroying previously successful business models (Malthouse et al., 2019; van Riel et al., 2019). An example can be found in the travel sector, where airlines use the Internet to sell tickets directly to customers, eroding the business model of traditional brick-and-mortar travel agencies earning sales commissions from airlines (McCubbrey and Taylor, 2005). Furthermore, customers use service platforms like Booking and Expedia to book combinations of flights, hotels, and rental cars with just a few clicks, which has changed the travel sector significantly. Such individualizable offerings recognize that customers often have complex needs that cannot be satisfied by a single service provider. This need for a customer-oriented, individualized combination of multiple services is also common in other sectors, such as education, finance, health, and mobility (Alt et al., 2019).

According to Willing et al. (2017a, p. 271) “long-distance travel booking was the forerunner […], with many established web-based offerings, such as online travel agencies (e.g. Expedia) and flight comparison websites (e.g. Kayak), mostly due to homogeneous supply. Short-distance urban travel [‘mobility’ would be a more precise term], however, has recently become more diverse”. This quotation illustrates the high complexity in the case of mobility due to the heterogeneity of services (e.g., public transport, car- and ride-sharing), the high number of service providers and significant regional differences. Based on the development in the travel sector, it can be expected that some actors will benefit from a change towards the platform economy, while the existence of other actors will be threatened.

The (potential) actors of a service ecosystem for smart mobility are heterogeneous and have different desires, priorities, and needs. In the following, we present the most important actors and point out knowledge gaps, starting with the **customers** of a smart mobility service. It is assumed that a change towards a more sustainable behavior in the broader public, such as a shift from private car use to the use of mobility services, depends on providing “the right information at the right time” (Watson et al., 2011, p. 59). In order to collect, share and disseminate accurate and timely information, service ecosystem actors avail themselves of a range of information systems, networks and tools. One such tool are apps for smart mobility. Such apps represent a marketplace where customers can inform themselves about the different mobility services and compare/combine them according to varying criteria (e.g., price, travel time, convenience), and sometimes purchase tickets (Willing et al., 2017a; 2017b). Ideally, such apps make it easier and more convenient to use multiple mobility services. Previous studies on (potential) customers’ preference structures for such service platforms have methodological shortcomings and provide only limited insights (Grotenhuis et al., 2007; Stopka, 2014). Willing et al. (2017b, p. 178) identify a clear role for information systems (IS) research in helping service platform providers identify the needs and preferences of their (potential) customers: “IS researchers can help to identify and define what constitutes a good intermodal value proposition regarding platform design and the definition of standards”.

A **mobility provider** can benefit from an app for smart mobility to the degree that it makes it easier and more convenient for (potential) customers to use their mobility service. Such customers may also be more aware of and find its mobility service more attractive if it is combined with one or more other mobility services. For instance, one of the main reasons for potential customers not to use public transport is its station-based nature (Beirão and Cabral, 2007). This service could be perceived as more attractive and beneficial if it is combined with a bike- or car-sharing service that ensures more seamless transport from an origin to a destination. However, smart mobility apps can also have potential disadvantages to mobility providers. For example, the app may cause mobility providers to lose direct contact with their customers and thus limit its business and marketing opportunities. For these reasons, there is a notable tendency of some hotels to limit intermediation through service platforms in the travel sector (Stangl et al., 2016).

In addition, there is no consensus on the degree to which and the conditions under which mobility services within a smart mobility service ecosystem are in a complementary or in a competing relationship. Specifically with regard to long-term behavioral change toward reduced personal car use, many authors (Caiati et al., 2020; Shaheen et al., 2009; Willing et al., 2017a) assumed a complementary relationship, since the attractiveness of each mobility service within the smart mobility service ecosystem increases vis-à-vis private car use. On the other hand, Willing et al. (2016) show that car-sharing can cannibalize the demand for public transport due to shorter travel times and higher levels of comfort and convenience.

Another actor in smart mobility service ecosystems are **public authorities**, such as national, state, regional, district, and city administrations. Public authorities aim to reduce the problems and external costs associated with the use of the private car, such as noise pollution, accidents, and the ecological effects of asphalting of surfaces to build roads and parking lots. In addition, the mobility sector accounts for the second highest percentage of greenhouse gas emissions in Germany (in 2018) (Umweltbundesamt, 2020a). Such greenhouse gases contribute to global warming, which endangers the health and well-being of the population and all living organisms on earth. It has been estimated that 13,000 deaths in Germany (in 2015) can be attributed to greenhouse gas emissions (Anenberg et al., 2019). It can be expected that the problems caused by the predominant use of private cars will continue to increase. Cities in particular need to find effective and efficient countermeasures, as the United Nations Department of Economic and Social Affairs (2015) predicts that the percentage of the global population living in cities will increase from 50% in 2015 to 66% by 2050. In order to reduce air pollution, the German government has recently imposed driving bans on diesel vehicles in some urban areas (ADAC, 2019).

Docherty et al. (2018) have identified many advantages to state involvement in transport governance, include guaranteeing and protecting mobility as a driver of economic growth, compensating for less than ideal free market conditions, the ability of the state to bear the costs of infrastructure, and the market advantages of stimulating and protecting innovation. Public authorities are often required or mandated to support, provide or procure unprofitable mobility services, such as to transport pupils to school, to provide mobility to and within less densely populated areas, and to provide public transport on days and at times when demand is limited. Most states consider public transport an important contribution to satisfying the mobility needs of their citizens. For example, in Germany, the number of trips conducted by public transport increased from 9.6 to 10.4 billion in the period between 2011 and 2018 (Verband Deutscher Verkehrsunternehmen, 2019).

Similarly, the popularity of public transport use among people living in the Netherlands is evidenced by the recently published study by Caiati et al. (2020). Their results showed that public transport (including bus, metro, and tram) is the most preferred mobility service when a choice between mobility services is available, as in the case of a smart mobility app. If a smart mobility app helps makes public transport more attractive to residents of the Netherlands who currently rely primarily on a private car to meet their mobility needs, then public authorities would want to cooperate with smart mobility app providers to achieve their superordinate goals of creating public value (e.g., low impact of transport on natural resources, ensuring well-being of the population) and fulfilling their mandate to provide or procure public transport. However, such public-private cooperation is not always free of barriers. Smith et al. (2019) study of (potential) cooperation between public and private actors in western Sweden revealed that national and European legislation, the lack of clear responsibilities, and work culture, among others, were negatively affected effective cooperation.

Digitalization has led to the emergence of a new actor, the **smart mobility app provider**. Individual mobility providers can provide information such as timetables, fares, and passenger counts (Ahlers et al., 2018) to a smart mobility app provider. Until relatively recently, mobility providers had primarily static information, but technological progress, especially in the field of sensors, enables real-time data to be collected. For example, mobility providers can detect vehicle positions and delays using sensors installed in the vehicles and/or stations or overfilled vehicles based on global positioning system (GPS) data from participating customers. In turn, smart mobility app providers can use such real-time data to offer customers a range of options they can choose from to reach their destination. Pappas et al. (2018, p. 482) call service ecosystems based on large amounts of data from numerous actors, potentially including mobility providers and customers, a “big data and business analytic ecosystem”. Willing et al. (2017a) argue that by applying big data analytics, economic opportunities for (individual) actors of the service ecosystem can be identified. For example, big data analytics can be used to optimize car-sharing business area boundaries or compare business models among mobility providers.

According to Gretzel et al. (2015, p. 179), such uses of data in the mobility sector can be regarded as ‘smart’, in that they are “technological, economic and social developments fuelled by technologies that rely on sensors, big data, open data, new ways of connectivity and exchange of information (e.g., Internet of Things, RFID, and NFC) as well as abilities to infer and reason”. In reality, however, comparisons of apps and websites for smart mobility available in German-speaking Europe (Albrecht and Ehmke, 2016; Willing et al., 2017a; 2017b) show that these apps and websites do not yet provide customers with truly smart mobility. Two of their main limitations are that they do not allow customers to book and pay for mobility services and that they often do not provide assistance during the trip – for example in the event of a cancellation or delay – because only static customer data is taken into account. In addition, fourteen apps and websites surveyed only include on average 6.22 different types of mobility services, ranging from three to twelve, and only five include the mobility services of at least one public transport company (Albrecht and Ehmke, 2016). A more recent study of smart mobility apps in the United Kingdom reveals similar results (Lyons et al., 2020). The reasons for these limitations are not clear.

From a theoretical viewpoint, the (intended) shift from the predominant use of the private car to the sequential use of mobility services, and the associated transformation of the mobility sector, represents a shift from the goods-dominant (G-D) to the service-dominant (S-D) logic. The S-D logic perspective was originally introduced into marketing by Vargo and Lusch (2004), but has since been used by scholars in numerous research fields, including service science (Gebauer et al., 2010; Vargo and Akaka, 2009, etc.), travel/transportation (Dolan et al., 2019;

Sthapit and Björk, 2019; Yin et al., 2019, etc.), and public business administration (e.g., Osborne, 2018; Osborne et al., 2013). An overview of its application in the IS field is provided by Brust et al. (2017). Their results showed that the S-D logic perspective was not at first used in a mobility context, but IS scholars have more recently applied it in mobility-related research (e.g., Gilsing et al., 2018; Hein et al., 2018; Turetken et al., 2019).

One of the main differences between the S-D and the G-D logic perspective is that the former assumes "that value is fundamentally derived and determined in use – the integration and application of resources in a specific context [i.e., service-for-service among actors, dyads, or triads (Chandler and Vargo, 2011)] – rather than in exchange – embedded in firm output [e.g., a manufactured vehicle] and captured by price" (Vargo et al., 2008, p. 145). In other words, a customer does not take a passive role, but interacts with the other actors in the service ecosystem through resource integration and service exchange to achieve value co-creation (Vargo and Lusch, 2004; 2017). For example, a smart mobility app user on a bus can provide information on how crowded the bus is (Nunes et al., 2014) or on whether the air conditioning or heating is working on the bus. Based on this information, the quality of the recommendations for other users can be improved. For this reason, the S-D logic perspective with its three main concepts service ecosystem, service platform, and value co-creation is suitable for this research.

Nonetheless, although the S-D logic perspective has become very popular in a number of research fields, its use is subject to some limitations. Probably the biggest limitation is that it is a meta-theoretical level perspective, making direct testing, verification, and application difficult (Vargo and Lusch, 2017). For this reason, much of current research taking the S-D logic perspective is conceptual in nature. In order to further develop the S-D logic perspective, scholars should pay an increasing attention to the two other levels of abstraction – the midrange-theoretical level (e.g., engagement, coproduction) and the micro-theoretical level (e.g., law of exchange and decision making). In this vein, Vargo and Lusch (2017, p. 46) made the following call for future research: "To support this theory of the market requires developing more midrange theoretical frameworks and concepts of service exchange, resource integration, value cocreation, value determination, and institutions/ecosystems. These midrange theories can be partially informed by theories outside of marketing […]. Evidence-based research is also needed; opportunities exist in areas such as […] the study of the service of cognitive mediators (assistants) as heuristic tools in complex service ecosystems".

Of particular interest in this thesis are the institutions and institutional arrangements (aggregations of institutions), which are defined as rules, norms, and beliefs (Vargo and Lusch, 2017), and represent "the rules of the game" (North, 1990, p. 3) that enable or constrain value co-creation among the actors of a service ecosystem (Koskela-Huotari et al., 2016). As the institutional arrangements, and thus the service ecosystems to which actors are connected by them, can be analyzed on various levels of aggregation and with "oscillating foci" (Chandler and Vargo, 2011, p. 41), a contextualization of value co-creation can be achieved.

1.2 Research Questions

The overall goal of this thesis is to improve our understanding of how to support the emergence and functioning, and thus the long-term viability, of service ecosystems for smart mobility. In other words, we focus on the (intended) shift from the G-D logic (reflected by buying and using a private car) to the S-D logic among actors. A challenge pointed out in scientific literature and experienced in practice (e.g., Albrecht and Ehmke, 2016; Willing et al., 2017a; 2017b). In this thesis, we will answer the following three research questions (RQ) by adopting the S-D logic perspective:

RQ1: *How do the resources of a smart mobility app provider constrain its value co-creation with (potential) customers?*

A focus of this thesis is on the role of the smart mobility app provider around which a service ecosystem is organized, the emergence of which is fueled by digitalization. According to the S-D logic perspective, value co-creation among actors consists of resource integration and service exchange (Vargo and Lusch, 2017). Two types of resources can be distinguished: Operand resources are those “resources on which an operation or act is performed”, such as algorithms and interfaces. In contrast, operant resources (e.g., capabilities, competences, knowledge, organizational processes, and skills) “are employed to act on operand resources” (Vargo and Lusch, 2004, p. 2).

Previous studies (Albrecht and Ehmke, 2016; Willing et al., 2017a; 2017b) analyze and compare several apps/websites for smart mobility in German-speaking countries and find a number of limitations (e.g., no possibility to book and pay, limited real-time journey information). However, it is unclear, whether (a lack of) the integration of operand or operant resources is the cause of these limitations. In their recent analysis of four European cities outside Germany, Wright et al. (2020) find that the poor quality of the data (an operand resource) provided by mobility providers is a cause of these limitations.

A two-step approach is chosen to answer this research question. First, an interdisciplinary literature review (Webster and Watson, 2002) is conducted to gain insights into the resources and their quality. Second, a conjoint analysis (Backhaus et al., 2015) is performed to identify the smart mobility app preference structures of potential customers. By comparing the results with the apps/websites available in the German-speaking European market (Albrecht and Ehmke, 2016; Willing et al., 2017a; 2017b), we evaluate how their integration constrains value co-creation with (potential) customers.

RQ2: *How does the service ecosystem of a mobility provider constrain its value co-creation with a smart mobility app provider?*

One limitation of smart mobility apps is the low number of available mobility services (e.g., public transport, car-sharing) and of mobility providers per mobility service (Albrecht and Ehmke, 2016; Willing et al., 2017a; 2017b). In this research question, we aim to understand how the institutional arrangements (i.e., rules, norms, and beliefs) of the service ecosystem in which a mobility provider is embedded constrain its value co-creation with smart mobility app providers.

In order to develop the S-D logic perspective towards a midrange theory, we draw on the concept of actor engagement, which is defined as “both the actor’s disposition to engage, and the activity of engaging in an interactive process of resource integration within a service ecosystem", as the microfoundation for value co-creation (Storbacka et al., 2016, p. 3008). Furthermore, following the recent call of Vargo and Lusch (2017), we use theories and concepts outside of marketing, namely role conflict theory (Koch and Schultze, 2011; Merton, 1957), institutional theory (Mignerat and Rivard, 2009; Suchman, 1995), power theory (Jasperson et al., 2002; Pfeffer and Moore, 1980; Simeonova et al., 2018), and the concept of technology choice (Drake et al., 2016; Liu et al., 2013) to complement the S-D logic perspective.

We undertake several qualitative studies to obtain insights into the lack of actor engagement among German mobility providers. For a comparison with the travel sector, we also conduct interviews with experts from hotel organizations. In addition, a qualitative comparative analysis (QCA) (Ragin, 2008; Rihoux and Ragin, 2009) is applied to show how the configuration of a service ecosystem, with regard to the actors and to the institutional arrangements that are present, is linked to the information technology (IT) choice of its actors. The choice of state-of-the-art IT is necessary to engage in value co-creation with a smart mobility app provider.

RQ3: *How can value co-creation among the actors in a service ecosystem for smart mobility be facilitated?*

In order to push the emergence and to ensure the functioning of service ecosystems for smart mobility, contributing to their long-term viability, it is necessary to establish value co-creation among their actors that include, among others, the smart mobility app providers, mobility providers, public authorities (e.g., national, state, regional, district, and city administrations), and customers. However, as Breidbach and Maglio (2016, p. 74) point out, "we know very little about how economic actors engage in the process of value co-creation in traditional, co-located contexts […], let alone in technology-enabled ones". This is a major research gap, as technological progress and ongoing digitalization are generating vast amounts of data (big data) from a growing number of sources, such as smartphones, business transactions, sensors installed in vehicles, and social media posts (Pappas et al., 2018), which offer new opportunities for value co-creation. For example, Willing et al. (2017a) explained the economic benefits that car-sharing companies can realize in the case of vehicle relocation and business area optimization if a smart mobility app provider applies business analytics.

To answer this research question, we conduct qualitative studies and a case study to gain insights into value co-creation of actors embedded in a service ecosystem for smart mobility. The focus is on creating knowledge of (1) how a value co-creation relationship is establish between a mobility provider and a smart mobility app provider, (2) what different types of value co-creation relationships between both types of actors have been established, and (3) how value co-creation among the different actors can be increased. Again, the S-D logic perspective is complemented with theories and concepts outside of marketing, namely activity theory (AT) (Engeström, 1987; Kuutti, 1996) and the concept of value co-destruction (Laud et al., 2019; Leroi-Werelds, 2019; Plé and Cáceres, 2010) to ensure a strong theoretical foundation.

1.3 Structure

This thesis consists of three parts: A, B, and C. In Part A, we have thus far formulated the problem statement and outlined the research questions. After describing the structure of the thesis, we preview the research problem, the methodological approach and the main results and contributions of the nine publications, provide the conceptual background, including an interdisciplinary perspective on the topic ‘mobility’, a definition of the term ‘smart mobility’, a description of the German mobility sector, and an introduction in the S-D logic perspective. Part A ends with a description of the mixed methods research design, which includes a literature review, a conjoint analysis, expert interviews, a QCA, and a case study.

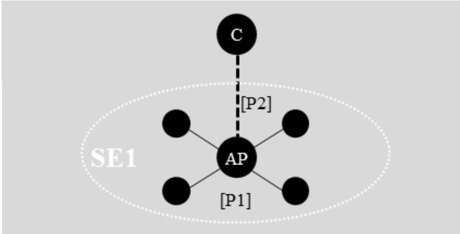
Part B provides an overview of the nine double-blind reviewed publications, which are reproduced in their original format in the Appendix. Two publications focus on the operand and operant resources that underlie the value co-creation of a smart mobility app provider with its (potential) customers. Four publications deal with the service ecosystem of different mobility providers and how their institutional arrangements constrain value co-creation (using actor engagement as the microfoundation) with a smart mobility app provider. The last three publications provide insights into the emergence of a value co-creation relationship and on established value co-creation relationships between mobility providers and smart mobility app providers. In addition, we show how value co-creation among the actors of a service ecosystem for smart mobility can be increased.

In Part C, we summarize the results of the publications and discuss the theoretical and practical implications of our work, its limitations, as well as avenues for future research. The thesis ends with a conclusion. An overview of the structure of the thesis is given in Figure 1.

Part A | **Introduction, conceptual background, mixed methods research design**

Part B | **Smart mobility app provider: An overview of its operand and operant resources**

RQ1: How do the resources of a smart mobility app provider constrain its value co-creation with (potential) customers?



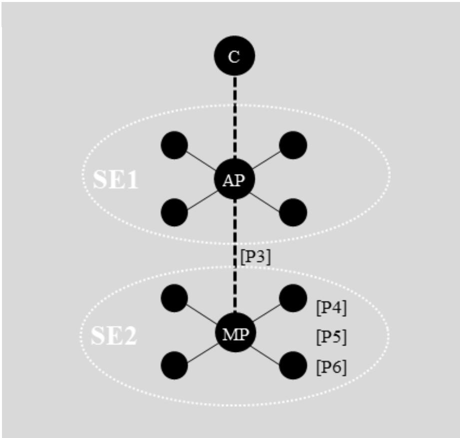
P1: Door-to-Door Mobility Integrators as Keystone Organizations of Smart Ecosystems: Resources and Value Co-Creation – A Literature Review

P2: Smart Mobility – An Analysis of Potential Customers' Preference Structures

Methods: Literature review, conjoint analysis

Service ecosystem of a mobility provider: The effects of institutional arrangements on its value co-creation

RQ2: How does the service ecosystem of a mobility provider constrain its value co-creation with a smart mobility app provider?



P3: The Long and Winding Road to Smart Integration of Door-to-Door Mobility Services: An Analysis of the Hindering Influence of Intra-Role Conflicts

P4: How Institutional Arrangements Impede Realization of Smart Ecosystems: The Case of Door-To-Door Mobility Integrators

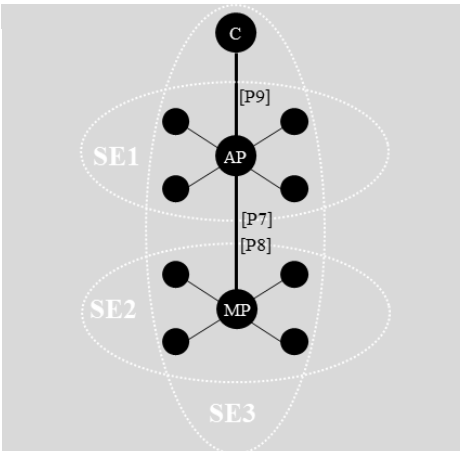
P5: How Countervailing Power Affects Value Co-Creation among Service Providers: A Comparison of the Travel and Mobility Sectors

P6: Information Technology Choice in Mobility Service Ecosystems: A Qualitative Comparative Analysis

Methods: Expert interviews, QCA

Service ecosystem for smart mobility: Value co-creation among its actors

RQ3: How can value co-creation among the actors in a service ecosystem for smart mobility be facilitated?



P7: Smart Mobility: Contradictions in Value Co-Creation

P8: The Negative Effects of Institutional Logic Multiplicity on Service Platforms in Intermodal Mobility Ecosystems

P9: Value Co-Creation and Co-Destruction in Service Ecosystems: The Case of the Reach Now App

Methods: Expert interviews, case study

Legend:
C: Customer
AP: App provider
MP: Mobility provider
SE: Service ecosystem

Part C | **Summary of results, discussion, conclusion**

Figure 1. Structure of the Thesis.

In the following, we briefly preview the research problem, the methodological approach and the main results and contributions of the nine publications (P).

[P1]: Door-to-Door Mobility Integrators as Keystone Organizations of Smart Ecosystems: Resources and Value Co-Creation – A Literature Review (Schulz et al., 2019). In this interdisciplinary literature review, we shed light on the operand and operant resources of smart mobility app providers (a synonym for door-to-door mobility integrators) that underlie their value co-creation. We provide a systematic overview of the state of knowledge regarding the different operand resources (e.g., interfaces, algorithms) and operant resources (e.g., capability to ensure security and privacy) and point out problems that occur in practice. For instance, the available algorithms can determine the shortest, the fastest, the cheapest, the most energy-efficient, or the least complex combination of multiple mobility services to get from an origin to a destination. However, the algorithms frequently require a long time to run. Hence, current algorithms illustrate the basic feasibility of the optimization idea rather than its practical usability. Our results show, in particular, that research into the operant resources is scarce. Based on the results, we derive central issues for future research, such as creating knowledge about the capability of smart mobility app providers to establish and manage value co-creation relationships with mobility providers and customers.

[P2]: Smart Mobility – An Analysis of Potential Customers' Preference Structures (Schulz et al., 2021a). One of the most important operand resources of smart mobility app providers is the app itself. While previous work has compared apps/websites available on the German-speaking European market, less is known about to what extent they meet the actual desires, priorities, and needs of (potential) customers. In order to improve our understanding of how apps constrain value co-creation among (potential) customers, we conduct two preliminary studies and a conjoint analysis with 523 people living in Germany. Our results show that the preference structures for the varying groups of potential customers that we formed vary significantly depending on their current mobility behavior, their age, and their place of residence. For instance, solely car drivers do not consider the price of the app important in making a choice. This research contributes to the literature on business models of smart mobility app providers and on the design of the apps by determining the importance of attributes (e.g., time-table information, app price) and attribute levels (e.g., static, mixed, and real-time information) for (potential) customers.

[P3]: The Long and Winding Road to Smart Integration of Door-to-Door Mobility Services: An Analysis of the Hindering Influence of Intra-Role Conflicts (Schulz et al., 2018). Triggered by technological progress and ongoing digitalization, the mobility sector is in a state of flux. New roles, such as that of the smart mobility app provider are emerging, and established roles, for example, that of public transport companies, are changing. Based on scientific literature on intermediaries in the field of electronic commerce, we develop a role framework for smart mobility app providers, which includes five roles: The informational, the transactional, the assurance, the logistical, and the customization role. By drawing on role conflict theory, we assume that intra-role conflicts are the cause of the lack of actor engagement among twelve German transport and tariff associations (regional representations of public transport companies). Our analysis reveals intra-role conflicts especially with regard to the logistical and the customization role. Many of the transport and tariff associations are not able to provide electronic/mobile tickets to smart mobility app providers. In addition, the transport and tariff associations would like to retain customer contact, and themselves offer a combination of multiple mobility services for a trip from an origin to a destination. This results contribute to a better understanding of the new emerging role of the smart mobility app provider.

[P4]: How Institutional Arrangements Impede Realization of Smart Ecosystems: The Case of Door-To-Door Mobility Integrators (Schulz and Überle, 2018). In this publication, we aim to understand how the institutional arrangements that fourteen German mobility providers (e.g., bike-sharing, car-sharing, and public transport companies) face due to their embeddedness in an existing service ecosystem constrain their value co-creation with smart mobility app providers. We complement the S-D logic perspective with the concept of legitimacy stemming from institutional theory and derive five possible legitimacy needs of mobility providers: The need to gain market, relational, social, investment, and smart service integrator legitimacy. Our results show that the mobility providers often perceive no need to engage in value co-creation with smart mobility app providers in order to gain legitimacy from the actors of their current service ecosystem, including, among others, citizens, municipalities, and shareholders. For instance, the mobility providers have investment legitimacy reflected by the obtained approval for cost-intensive investments in new equipment needed, for example, to provide real-time timetable data and mobile tickets. This study contributes to the S-D logic literature with a focus on institutional arrangements and the related topic of contextualization of value co-creation.

[P5]: How Countervailing Power Affects Value Co-Creation among Service Providers: A Comparison of the Travel and Mobility Sectors (Schulz and Ikonomou, 2020). The institutional arrangements that are present in the service ecosystem of each mobility provider can not only constrain its value co-creation by not creating a need for legitimacy. In this publication, we complement the S-D logic perspective with the concept of countervailing power to understand how the existing institutional arrangements restrict the price and place policies of mobility providers, which in turn negatively affect their ability to develop and maintain countervailing power against smart mobility app providers. Expert interviews with 26 German hotel and public transport organizations show that the price policies of public transport organizations are often characterized by the setting of non-dynamic and uniform prices. In addition, their place policies are limited by the lack of free choice of distribution channels, as well as a long-term price and quantity optimization due to different institutional arrangements (e.g., the goal of public authorities to enable elderly people without smartphone access to affordable mobility). By comparing their price and place policies which these of hotel organizations, we can provide insights into how the institutional arrangements should be adapted in order to increase their ability to build up countervailing power. This work contributes to a more pronounced understanding of the economic obstacles that constrain value co-creation by mobility providers, which arise from the existing institutional arrangements of their service ecosystem.

[P6]: Information Technology Choice in Mobility Service Ecosystems: A Qualitative Comparative Analysis (Schulz et al., 2020a). The IT choice of a mobility provider influences its technical disposition to engage in value co-creation with smart mobility app providers. However, a mobility provider does not choose its IT completely independently because it is embedded into a service ecosystem that includes different actors connected by institutional arrangements. For example, German public transport companies (e.g., bus, subway, and tram companies), are usually members of a transport and tariff association that includes additional public transport companies, customers, as well as often public authorities (e.g., state, regional, district, and city administrations), and other mobility providers (e.g., bike-, car-, and ride-sharing companies). In practice, these service ecosystems are very heterogeneous with regard to their actors and institutional arrangements and it is unclear how this heterogeneity is linked to the IT choice of their actors. To fill this gap, we conduct a QCA based on interview data collected from twelve German transport and tariff associations and secondary data. The QCA is a set-theoretic method and has only recently gained a certain popularity in the IS field. In other words, in contrast to traditional regressions-based models, where the net effect of each factor on the outcome is determined, its focus is on the configuration of several attributes (the actors and the institutional arrangements of a transport and tariff association). The results show in particular that the availability of a high number of car-sharing actors in the geographical area of a transport and tariff association is a necessary condition for the choice of state-of-the-art IT. By adding the concept of IT choice to the S-D logic literature, we improve our knowledge about the IT choice of mobility providers, and thus on the technical obstacles that constrain their value co-creation with smart mobility app providers.

[P7]: Smart Mobility: Contradictions in Value Co-Creation (Schulz et al., 2020c). So far, the scientific literature only provides comparisons of apps/websites available for smart mobility in German-speaking European countries. However, possible solutions for the identified limitations, such as a low number of participating mobility providers and no possibility to book and pay for mobility services, which are based on a lack of value co-creation by mobility providers, have not yet been proposed. In this publication, we complement the S-D logic perspective with AT to illustrate how contradictions that are present in the activity system of a mobility provider and the pursuit of congruence can lead to the establishment of a value co-creation relationship with a smart mobility app provider. In order to obtain empirical evidence, a qualitative study is conducted with twelve German transport and tariff associations. Our results illustrate how in one case a number of adaptations are initiated by a transport and tariff association and a smart mobility app provider (among others, the introduction of a white label app) to enable value co-creation. With our AT-enriched S-D logic perspective, we provide a blueprint for future research that can be used for the analysis of (lacking) value co-creation, especially in an IT-enabled context.

[P8]: The Negative Effects of Institutional Logic Multiplicity on Service Platforms in Intermodal Mobility Ecosystems (Schulz et al., 2020b). Even if different actors, such as mobility providers, have established value co-creation relationships with a smart mobility app provider, there may be obstacles that constrain their value co-creation. Based on the institutional literature, we question the assumption of the S-D logic perspective that the service logic is dominant for all actors embedded in a service ecosystem. Subsequently, by applying AT, we postulate how contradictions are induce into an activity system (unit of analysis for a service ecosystem) by logic multiplicity among its actors, which limit the functional range of the service platform. We test our theoretical arguments on data collected in four German service ecosystems for smart mobility that include actors, such as the state ministry, region and city administrations, public transport companies, car park operators, and smart mobility app providers. The sixteen expert interviews conducted reveal, for example, that the state and civil society logic of some actors, as for instance reflected by the goal of maintaining data sovereignty, prevent the sale of tickets via a smart mobility app. With our research, we contribute to a better understanding of the link between institutional logics (a synonym for institutional arrangements) and technology, which is underexplored in the IS literature. In addition, we contribute to the S-D logic literature by underscoring the need to take into account logic multiplicity during the analysis of (IT-enabled) value co-creation.

[P9]: Value Co-Creation and Co-Destruction in Service Ecosystems: The Case of the Reach Now App (Schulz et al., 2021b). Technological progress and digitalization are also changing the role of automotive manufacturers. While their previous focus was on the production of vehicles, it is increasingly shifting to the provision of mobility services, such as car- and ride-sharing (which represents a shift from the G-D logic to the S-D logic). In addition, Daimler AG and the BMW Group launched a joint venture, the Moovel Group GmbH, to take the role of the smart mobility app provider. While the previous studies compare apps/websites for smart mobility in German-speaking European countries by taking the neutral position of an observer, there is currently no knowledge how value formation takes place between an app provider and its customers. In order to gain insights into this question, we analyze customer reviews for the Reach Now app provided by the Moovel Group GmbH in the Android Google Play Store between 2016 and 2019. Furthermore, we conduct expert interviews with six German transport and tariff associations, which are members of the service ecosystem of the Moovel Group GmbH, in order to better understand the value formation in the relationships between a smart mobility app provider and mobility providers. Our results help to create awareness among (IS) researchers for the concept of value formation that focuses on value co-creation and value co-destruction. In addition, we contribute the S-D logic literature by going beyond the study of single dyadic actor-to-actor relationships of a service ecosystem, by analyzing the link between the value formations in both dyadic actor-to-actor relationships. Table 1 provides an overview of the publications embedded in this thesis. Appendix M contains a list of further publications with a focus on (smart) mobility, which are not part of this thesis.

Research question	No.	Authors	Title	Outlet – Publication date	VHB-Ranking[1]
RQ1	P1	Schulz, Böhm, Gewald, Krcmar	Door-to-Door Mobility Integrators as Keystone Organizations of Smart Ecosystems: Resources and Value Co-Creation – A Literature Review	International Conference on Wirtschaftsinformatik (WI) – 2019	C
	P2	Schulz, Böhm, Gewald, Krcmar	Smart Mobility – An Analysis of Potential Customers' Preference Structures	Electronic Markets (EM) – 2021	B
RQ2	P3	Schulz, Gewald, Böhm	The Long and Winding Road to Smart Integration of Door-to-Door Mobility Services: An Analysis of the Hindering Influence of Intra-Role Conflicts	European Conference on Information Systems (ECIS) – 2018	B
	P4	Schulz, Überle	How Institutional Arrangements Impede Realization of Smart Ecosystems: The Case of Door-To-Door Mobility Integrators	European Conference on Information Systems (ECIS) – 2018	B
	P5	Schulz, Ikonomou	How Countervailing Power Affects Value Co-Creation among Service Providers: A Comparison of the Travel and Mobility Sectors	Pacific Asia Conference on Information Systems (PACIS) – 2020	C
	P6	Schulz, Böhm, Gewald	Information Technology Choice in Mobility Service Ecosystems: A Qualitative Comparative Analysis	International Conference on Information Systems (ICIS) – 2020	A
RQ3	P7	Schulz, Gewald, Böhm, Krcmar	Smart Mobility: Contradictions in Value Co-Creation	Information Systems Frontiers – 2020	B
	P8	Schulz, Böhm, Gewald, Celik, Krcmar	The Negative Effects of Institutional Logic Multiplicity on Service Platforms in Intermodal Mobility Ecosystems	Business & Information Systems Engineering (BISE) – 2020	B
	P9	Schulz, Zimmermann, Böhm, Gewald, Krcmar	Value Co-Creation and Co-Destruction in Service Ecosystems: The Case of the Reach Now App	Technological Forecasting & Social Change – 2021	B

[1] VHB: German Academic Association for Business Research

Table 1. Overview on the Embedded Publications.

2 Conceptual Background

In this section, we provide the conceptual background of this thesis. First, we underscore our interdisciplinary approach by outlining the theories and concepts from a spectrum of fields of research. We then define and discuss the term ‘smart mobility’. Subsequently, we explain our focus on the German mobility sector as context for our research. Lastly, we introduce the S-D logic perspective with its three main concepts ‘service ecosystem’, ‘service platform’, and ‘value co-creation’ as our meta-theoretical lens.

2.1 Mobility: An Interdisciplinary Perspective

Mobility is intertwined with many aspects of society and intersects with many fields of research. This section introduces the primary research fields this thesis draws on, outlines the current state of knowledge with regard to mobility and outlines its potential contributions to better understanding smart mobility.

Transportation science investigates the mobility behavior of people and the technical and nontechnical challenges that mobility providers face in providing their service. Scholars in this field focus on public transport provision, barriers to its use, and how its quality can be improved. Several studies (e.g., Abenoza et al., 2017; Haywood et al., 2017; Mouwen, 2015) measure customer satisfaction with public transport services and identify the drivers of satisfaction (e.g., on-time performance and frequency of service), and dissatisfaction (e.g., overcrowding).

Other scholars (Jin et al., 2016; Mahéo et al., 2019; Steiner and Irnich, 2020; Takamatsu and Taguchi, 2020; Wong et al., 2008, etc.) focus on how timetable planning can be improved to increase the quality of the public transport service, such as to avoid waiting times between two scheduled public transport services. To achieve a favorable trade-off between low waiting times (i.e., a high service quality) and low operation costs, Petersen et al. (2013) proposed a new timetable planning approach.

Another way to increase customer satisfaction is by providing high-quality timetable information. In the past, the aim of public transport companies was usually to identify and to inform about the route with the shortest travel time and/or the smallest number of transfers. Goerigk et al. (2014) develop a heuristic that determines the most reliable route for a trip between an origin and a destination so that customers reach their planned destination even in the case of delays.

A further stream of research deals with the provision and use of other mobility services, such as bike-, car-, and ride-sharing, partly as a supplement to public transport in order to address the so-called last mile problem. Some studies take a provider perspective and focus on solving the challenges related to providing these services (Brandstätter et al., 2020; Chen et al., 2019; Frade and Ribeiro, 2015; Franco et al., 2020, etc.). For example, Yang et al. (2020) developed a numerical model to calculate the optimal number of taxis for a given city, and Datner et al. (2019) focused on the determination of the optimal inventory level of bike-sharing stations. In addition, some studies contributed to solve the matching problem in the case of car-sharing (Ströhle et al., 2019) and ride-sharing (Li et al., 2020; Wang et al., 2018a). Agussurja et al.

(2019) developed a Markov decision process framework for the generation of a vehicle-dispatching policy that addresses the problems of demand uncertainty and a demand in batches when combining public transport and ride-sharing.

Other studies take a customer perspective and analyzed the reasons for the use or lack of use of these mobility services among different groups of (potential) customers (e.g., Li and Kamargianni, 2020; Wang et al., 2018b). For instance, Böcker et al. (2020) showed that bike-sharing, whether alone or in combination with public transport, is used less by women and older people.

Another stream of research examines the choice of a mobility service, in particular, subsequently to the use of a specific mobility service (e.g., Hamidi et al., 2019; Klingen, 2019; Zhao and Li, 2017). For example, the results of Yap et al. (2016) showed that first class train customers prefer to use an autonomous vehicle for their egress stage, rather than public transport or bicycle.

In the field of **sustainability management**, the focus is on the extent to which the current mobility behavior has a negative impact on the environment and how the mobility behavior can be changed with the aim of reducing this impact. For example, Laakso (2017) conducts an experiment in which participants gave up car ownership and received free bus travel cards for six month. Her results showed that the greenhouse gas emissions caused by the everyday mobility of the participants could be reduced by 43% on average during the experiment. Furthermore, the results indicated that the de-routinization of mobility in the participant groups is differently difficult, for example depending on the demands of working and parenting.

Similar studies were conducted for the case of car-sharing (for an overview, see Firnkorn and Shaheen, 2016). For instance, Nijland and van Meerkerk (2017) showed that among the study participants who use car-sharing, the percentage of car ownership is over 30% lower than for non-users. In addition, car-sharing users drove 15% to 20% fewer car kilometers than prior to using car-sharing. Due to their changed mobility behavior, car-sharing users caused between 240 and 390 fewer kilograms of carbon dioxide per person and per year. This represents a reduction in carbon dioxide emissions between 13% and 18% compared to private car ownership and use. Furthermore, according to Amatuni et al. (2020), car-sharing participation reduces the annual total mobility-related life-cycle greenhouse gas emissions caused by a member between 3% and 18% (previous studies estimated a value of up to 67%).

Unsurprisingly, health and environmental benefits are the most important motivation factors for the use of bike-sharing (Cerutti et al., 2019). However, a change in current mobility behavior does not necessarily contribute to greater environmental and social sustainability. In their study of bike-sharing in Shanghai, for example, Ma et al. (2018) describe an oversupply of shared bikes, resulting in unused resources. A further problem that negatively affects sustainability is user misbehavior (e.g., theft, vandalism).

Service science research into mobility services focuses on service innovation and provision. Insights from this field of research can help illuminate the development, introduction, and management of apps for smart mobility. In comparison to goods, services are characterized by several characteristics, namely intangibility, heterogeneity, perishability, increased customer interactivity, and simultaneity between production and consumption (Randhawa and Scerri, 2015; Stare and Rubalcaba, 2008). As applied to mobility services, for example, bus transport is perishable and consumed simultaneously with its production. A bus drives from station to station as per a timetable, which causes costs (e.g., infrastructure, personnel, fuel) regardless of ridership levels. Due to these characteristics, mobility services are developed and managed differently from goods.

The concept of service innovation has been the focus of much scholarship (Carlborg et al., 2014; Witell et al., 2016). Randhawa and Scerri (2015, p. 30) posit that “service innovation also entails technology and processes to better manage demand and plan capacity”. By using IT and taking a big data approach, smart mobility app providers can, for instance, recommend alternative mobility services in the case of crowded public transport to customers. In addition, the data can be used to optimize the capacity management of car-sharing and taxi companies by taking into account the capacity situation in public transport (e.g., a possible overcrowding, number of people requiring additional mobility services).

IS research into mobility services focuses on how different actors use IT, often to support the establishment and diffusion of shared services. Examples are the relocation of car-sharing vehicles (Brendel et al., 2018), and IT-based effort to prevent or reduce moral hazard among car-sharing users (Hildebrandt et al., 2018). Some IS researchers (e.g., Gilsing et al., 2018; Hildebrandt et al., 2015; Turetken et al., 2019) also discuss the creation and design of business models based on the new technical possibilities. In contrast, Schreieck et al. (2016) take a more technical perspective and examined the modularization of apps and websites for urban mobility.

Previous studies that focus on apps and websites facilitating a comparison or combination of multiple mobility services are particularly relevant for this work. Important insights are provided by Albrecht and Ehmke (2016) and Willing et al. (2017a; 2017b), who compare such solutions available for German-speaking European countries. They find that very few mobility providers offer their services via these apps and websites and that customers are often not supported in the agreement (i.e., booking and payment) and execution phase of their trip. Callegati et al. (2017) described the security and privacy issues innate to this context, most significantly insider threats, and discussed approaches to mitigate them.

Rehm et al. (2017) visualize the actors, such as different mobility providers and public authorities, constituting a mobility ecosystem and Willing et al. (2016) examine the competitive situation between two such actors, namely car-sharing and public transport companies. Their results illustrated that mobility services often complement each other, but in the city center there is a cannibalization of public transport demand through car-sharing based on its increased comfort.

Overall, these studies underscore that a single company is often not able to satisfy complex customer needs. This applies to the mobility sector as well as in many other sectors, such as education, finance, health, and tourism. Intermediaries, such as providers of apps and assistants based on artificial intelligence, can better satisfy complex customer needs by combining the services of several providers (Alt et al., 2019). The Delphi studies of McCubbrey (1999) and

McCubbrey and Taylor (2005) focusing on the relationships between airlines and their distribution partners, such as travel agencies and websites, can help to better understand the concepts of intermediation, disintermediation and reintermediation.

Kotler and Armstrong (2010, p. 29) define **marketing** as “the process by which companies create value for customers and build strong customer relationships in order to capture value from customers in return”. The marketing mix represents the instruments that a company uses to implement its marketing strategy, which are traditionally categorized into price, product, place, and promotion policies. When customers book and pay for services from several mobility providers via a smart mobility app, a number of marketing issues emerge. Mobility providers, for example, consider whether their mobility services and/or pricing should be differentiated depending on the distribution channel (e.g., app, website, ticketing machine). Smart mobility app providers consider market segmentation (i.e., target group), mobility service price bundling, and dynamic pricing.

While marketing literature addresses these questions broadly (e.g., Kotler and Armstrong, 2010; Silk, 2006), only few studies focus specifically on mobility. Shugan et al. (2017) illustrate that airlines pursue a different bundling strategy than hotels. Airlines usually bundle a first class flight with additional services (e.g., breakfast and entertainment), while hotels bundle a cheap room with additional services. Mantin and Rubin (2016) analyze dynamic price setting practices among airlines, revealing that when fare forecasting websites are available, the price decreases approximately between 4% and 6% per transaction. Bardhi and Eckhardt (2012) focus on the outcomes of access-based consumption in the case of car-sharing, finding, among other things, that the use of car-sharing is motivated by the self-interest of the users and utilitarianism guided by norms of negative reciprocity.

Smart mobility app providers can be viewed as a form of social, sustainable, and environmental **entrepreneurship** whose primary goal is to solve the social challenge (Thompson et al., 2011) of fulfilling the mobility needs of people while avoiding the negative effects of private car use (e.g., air and noise pollution). Pankov et al. (2019) examine the contextual factors of sustainable entrepreneurial ecosystems by using the example of sharing companies (e.g., bike-, car-, and ride-sharing companies). Their results highlighted that two sets of contextual factors influence how sharing companies pursue sustainable activities. The first set consists of contextual factors that enable the development of organizational capabilities and that enforce the adaptation of behavioral rules. The second set comprises contextual factors that impede the organizational agility of the sharing companies and that suppress their future growth.

Grinevich et al. (2019) analyze how providers of a sharing platform (e.g., car-sharing and carpooling) adopt institutional logics in addition to green logic, in particular economic and social logic, to achieve growth of their platform. Taking the green logic can lead to environmental benefits, for instance, by facilitating the use of underutilized and redundant resources (Grinevich et al., 2019), and thus corresponds to the considerations of social, sustainable, and environmental entrepreneurship. Furthermore, several of the app providers are start-ups, a special type of company on which entrepreneurship research focuses (Draebye, 2019).

(Public) business administration research focuses on the establishment and management of relationships between public and private organizations, such as when a public authority contracts a private public transport company to provide public transport services. However, public and private organizations usually have different interests and pursue varying goals, which negatively affect their cooperation (Dibben, 2006; van de Walle, 2008). For instance, Smith et al. (2019) identified a number of internal and external obstacles, such as the national and European legislation, unclear responsibilities, and the work culture, that hampered an intended cooperation between a regional public transport authority and private organizations. Several other studies (e.g., Gagnepain and Ivaldi, 2017; Lodi et al., 2016) have considered the design of contracts governing the cooperation between a public authority and public transport operators.

Another stream of research addresses the question of how public authorities are able to successfully fulfill their public tasks in the case of mobility (e.g., preserving natural resources). Some studies focus on the outcome of the cooperation between public and private organizations (Zullo, 2008). For example, Leland and Smirnova (2009) point out that there is no difference in effectiveness and efficiency between urban bus transit provided by public and private providers in the United States. Gallego et al. (2013) and Liu et al. (2016) illustrate that imposing driving restrictions is not sufficient to shift the mobility behavior from the use of the private car to the use of mobility services, such as public transport. However, a company-initiated advertising and promotion can contribute to fostering the use of public transport (Gijsenberg and Verhoef, 2019).

A further stream of research explores the economic and social impact of public transport provision. For example, Faulk and Hicks (2010) find that United States counties with small to medium-sized cities with bus transit have significantly lower unemployment rates and lower growth in family assistance than such counties without bus transit.

Strategic management is defined as "the management of an organization's resources to achieve its goals and objectives. Strategic management involves setting objectives, analyzing the competitive environment, analyzing the internal organization, evaluating strategies and ensuring that management rolls out the strategies across the organization" (Choudhury, 2018). Paik et al. (2019) examined the competitive environment of ride-sharing companies, such as Lyft and Uber, and especially the regulatory obstacles they face. An analysis of the bans of ride-sharing companies in cities of the United States between 2011 and 2015 finds that politicians who face little politician competition (e.g., due to a long tenure in office) are more likely to ban ride-sharing companies.

Firnkorn and Müller (2012) evaluate the strategy of an established automotive manufacturer (Daimler AG) to launch a car-sharing system (car2go), finding that the number of private cars can be reduced by offering car-sharing, thus creating a potential for environmental benefits. Further studies focused on the strategy of car-sharing companies by analyzing the adoption of car-sharing among customers. Hahn et al. (2020) show that car-sharing adoption depends on different dimensions of their business model, such as the price model and the pickup and drop-off mode. Similarly, Peterson and Simkins (2019) emphasize that in particular subjective norms, which are defined as thoughts of important others, influence the car-sharing adoption.

2.2 What is Smart Mobility?

In this section, we define the term ‘smart mobility’. Possibly as a result of the interdisciplinary nature of the topic of mobility, scholars have used various terms to describe the comparison and combination of multiple mobility services, such as ‘intermodal mobility’ (e.g., Jones et al., 2000; Schröder et al., 2014), ‘multimodal mobility’ (van Nes and Bovy, 2004; Willing et al., 2017a, etc.), and ‘mobility as a service’ (MaaS) (e.g., Caiati et al., 2020). However, the concepts behind these terms overlap and are still developing, as in the case of MaaS (Caiati et al., 2020; Lyons et al., 2020).

For consolidation purposes, we compare and contrast a range of definitions focusing on three core criteria: scope of the solution, use of IT, and types of mobility services in focus. Table 2 provides exemplary definitions of the terms. Since some scholars (e.g., Groth, 2019; Lyons et al., 2020; Schikofsky et al., 2020) used other terms in their definitions, there is a lack of clarity.

Term / Author(s)	**Definition**
Co-modality	
Dotoli et al. (2017, p. 2397)	“Co-modality, instead, arises from the need to convey people on a single means of transport to reduce the impact on environment, costs, and accidents. Hence, co-modality refers to the optimal use of different transportation modes on their own or in combination, taking advantage of ridesharing (the sharing of vehicles by passengers).”
Skoglund and Karlsson (2012, p. 933)	“The latest type of travel planners is the multi- or co-modal travel planner, combining private and public modes of transport, e.g. private car and/or cycle and/or bus.”
Mobility integration	
Boero et al. (2016, p. 1155)	“So, the objective is to holistically address the efficient and seamless integration and use of complementary, capacity-limited mobility services in the overall urban travel chain, including all transport modes (motorised and non-motorised, EVs, public transport, flexible services such as transport on-demand) and mobility sharing schemes (e.g. car sharing, motorbike sharing and carpooling).”
Motta et al. (2015, p. 3)	“Mobility Integrator is an innovative approach that integrates Information & Planning, Transport Services, Infrastructure and Traffic Management. In short, it shall provide a smooth and convenient integrated mobility platform. In a technological perspective, a mobility integrator is the integration of various systems, namely Traffic Management Systems, Transport Systems, User Systems, and Vehicle Systems.”
Intermodal mobility	
Jones et al. (2000, p. 349)	“Intermodal transportation should be generally defined as: the shipment of cargo and the movement of people involving more than one mode of transportation during a single, seamless journey.”

Schröder et al. (2014, p. 200)	"We define an intermodal trip as the usage of several transport modes during one trip, e.g. a trip with public transport in combination with bike or private car (park-and-ride)."
Willing et al. (2016, p. 1)	"Intermodal mobility, the IT-enabled, seamless transition between different modes of transportation to reach one's destination, is a promising approach towards reducing the environmental footprint of urban mobility."
Mobility as a service (MaaS)	
Caiati et al. (2020, p. 124)	"[…] MaaS as a mobility distribution model that offers the integration of a variety of transportation modes, either traditional (e.g. bus, tram, metro, taxis) or innovative (e.g. car sharing, bike sharing, ride sharing, demand responsive transit), combined with other transport-related services (e.g. travel recommendation system, ticketing, booking and payment services). They are offered by different public and private operators through a single integrated platform accessible to individuals and households through a subscription plan."
Lyons et al. (2020, p. 21)	"It is characterised by: door-to-door convenience […]; seamless, integrated, multi-modal travel […]; and ease of payment/billing […]. MaaS is enabled in technological terms by the connectivity and functionality offered by the mobile internet and related devices, notably smartphones".
Schikofsky et al. (2020, p. 297)	"[…] it becomes obvious that MaaS is mostly associated with a 'user centricity paradigm', 'intermodality/multimodality support', and 'integration'. The first one mainly refers to individual mobility services, preference-based mobility configuration and mobility choices based on individual needs. […]. 'Intermodality/multimodality support' refers to accessing multiple transport modes, the possibility of combining different modes of transportation within a travel chain or changing modes of transportation over time. 'Integration' refers to a single integrated application or gateway, the offering of a consistently integrated mobility service (that appears to be) from a single source, and an integrated single account and payment system."
Multimodal mobility	
Nobis (2007, p. 35)	"'Multimodality' is defined as the use of at least two modes of transportation—bicycle, car, or public transportation—in 1 week."
van Nes and Bovy (2004, p. 226)	"In this article we mean with multi-modal the combination of two or more different forms of transport within a single trip from origin to destination. This may consist of different vehicles, such as car, bicycle, tram, bus or train, or different services, such as stop or express services."
Willing et al. (2017a, p. 268)	"[…] multimodal mobility platforms (MMPs) have emerged, which aim to find the best route for the user by comparing multiple modes of transportation. After entering a desired destination, users obtain information about the different transport options, for example regarding costs and travel time. Depending on their preferences, they might choose the fastest, the cheapest, the most comfortable or the most environmentally friendly trip. Several platforms also enable payment for the journey and thereby function as

	marketplaces for sometimes complementary and sometimes competing mobility services.”
Smart mobility	
Groth (2019, p. 56)	“Modern information and communication technologies (ICTs) – e.g., smartphones – are seen as the digital key to a multimodal world […]. ICTs enable people to switch ‘smart’ between different interconnected mobility services such as carsharing, bikesharing, ridesharing, bus, train, tram, etc. in real-time.”
Wolter (2012, p. 528 - translated)	“[…] an offer that enables an ‘energy-efficient’, ‘low-emission’, ‘safe’, ‘comfortable’, and ‘cost-effective’ mobility, which is used intelligently by the traffic participant. It is about the optimization of the use of existing offerings through the use of information and communication technologies. […]. The environmental alliance focuses on public transport. It is supplemented by Park+Ride and additional feeder systems that make the rural area accessible. New mobility service (car- and bike-sharing) are established. […]. An intelligent use of these mobility services, which is reflected in the choice of mobility services depending on the current traffic situation, fails, however, because of the different access requirements for these mobility services.”

Table 2. Overview of Exemplary Definitions.

The first criterion that can be used to disclose the similarities and differences of the various definitions and the underlying concepts is the **focus of the solution**. A number of scholars (e.g., van Nes and Bovy, 2004; Willing et al., 2016) refer solely to a combination of multiple mobility services for a trip. But some scholars also focus on the use of single mobility services. For instance, Dotoli et al. (2017, p. 2397) define “co-modality” as “the optimal use of different transportation modes on their own or in combination”. Similarly, Masuch et al. (2013, p. 397) explain that “an intermodal route […] may involve different modes of transportation”. Furthermore, the definitions and concepts vary with regard to the part of the trip that is covered. For example, a train and a subsequent bus ride is a combination of two mobility services, but does not necessarily ensure a mobility from an origin to a destination (i.e., from door to door). In this vein, for instance, Gogos and Letellier (2016, p. 3219) emphasize the need to provide a solution, which considers “the first and last mile”.

A second criterion are the **types of mobility services** in focus in the definition. A special kind of mobility service is the use of the private car, bicycle or scooter for a part of the trip (Hoogendoorn-Lanser et al., 2006; Hrncir and Jakob, 2013; Prandtstetter et al., 2013; Schröder et al., 2014, etc.). Due to a lack of involvement of a mobility provider, these are called ‘self-services’. Further definitions include public transport, such as bus, subway, train, and tram (e.g., Boero et al., 2016; Caiati et al., 2020), as well as flight services for long distances (Gogos and Letellier, 2016; Jittrapirom et al., 2017). In addition, some scholars highlighted the need to consider sharing services, more precisely, bike-, car-, and ride-sharing (e.g., Dotoli et al., 2017; Groth, 2019; Prandtstetter et al., 2013). Other mobility services that are taken into account are on-demand services such as taxis (e.g., Caiati et al., 2020; Hrncir and Jakob, 2013), while electric mobility services represent a further concretization of the already mentioned mobility services (Boero et al., 2016; Prandtstetter et al., 2013).

Lastly, the definitions vary with regard to the **IT that is used** to provide a high-quality tailor-made solution. IT can support the comparison, selection, and match of mobility services taking into account preferences of individual customers, among others, with regard to price, carbon dioxide emission, and travel time (e.g., Jittrapirom et al., 2017; Masuch et al., 2013; Schikofsky et al., 2020). Furthermore, IT allows to consider the context and its changes, such as cancellations, delays, and inclement weather (Giesecke et al., 2016; Wolter, 2012, etc.). This data can be used to provide customers with dynamic recommendations during the trip (Callegati et al., 2017). In Table 3, the presented and additional definitions are classified according to the criteria. Our classification shows that the definitions for 'intermodal' and 'multimodal' mobility (e.g., Jones et al., 2000; van Nes and Bovy, 2004) usually reflect a relatively traditional view on the mobility services, in particular on the transport services. In contrast, 'MaaS' and 'smart mobility' (Groth, 2019; Lyons et al., 2020, etc.) put an additional focus on the value of IT for making the use of multiple mobility services more comfortable and convenient for customers.

Term / Author(s)	**Focus of the solution**		**Types of mobility services**						**IT use**			
	Service combination during a trip	Trip from door to door	Self-service	Public transport service	Flight service	Sharing services	On-demand services	Electric mobility service	IT focus (in general)	Individual solution	Context-aware solution	Dynamic solution
Co-modality												
Dotoli et al. (2017)	○					●			●			
Skoglund and Karlsson (2012)	●		●	●					●			
Mobility integration												
Boero et al. (2016)	●			●		●	●	●	●			
Motta et al. (2015)									●			
Intermodal mobility												
Jones et al. (2000)	●											
Masuch et al. (2013)	○								●	●		
Prandtstetter et al. (2013)	●		●	●		●		●	●			
Schröder et al. (2014)	●		●	●								
Willing et al. (2016)	●	●							●			

Mobility as a service (MaaS)												
Caiati et al. (2020)				●		●	●		●			
Callegati et al. (2017)	●								●			●
Giesecke et al. (2016)	●								●	●	●	
Jittrapirom et al. (2017)	○			●	●	●	●		●	●	●	
Lyons et al. (2020)		●							●			
Schikofsky et al. (2020)	○								●	●		
Multimodal mobility												
Gogos and Letellier (2016)	●	●		●	●				●			
Hoogendoorn-Lanser et al. (2006)	●		●	●								
Hrncir and Jakob (2013)	○		●	●		●	●		●			
Nobis (2007)			●	●								
van Nes and Bovy (2004)	●	●	●	●								
Willing et al. (2017a)	○	●							●	●		
Smart mobility												
Groth (2019)				●		●			●		●	
Wolter (2012)			●	●		●			●		●	

● Fully
○ In part

Table 3. Classification of Exemplary Definitions.

On the basis of this classification, this thesis is grounded on the following conceptual understanding. From a perspective focusing on the mobility behavior of people, we distinguish between monomodality, multimodality, and intermodality. A monomodal mobility behavior exists if only one mobility service, usually the private car, is used in a defined period of time (e.g., in one week, in one month). In contrast, multimodality is characterized by the use of at least two mobility services (e.g., private car and public transport) in a fixed time period (Nobis, 2007). Following the majority of the presented definitions (e.g., Jones et al., 2000; Prandtstetter et al., 2013), we understand intermodality as the use of at least two mobility services for a single trip. For example, in order to get home from the bus station, someone can ride a shared bike.

By combining at least two mobility services, an intermodal mobility behavior always also represents a multimodal mobility behavior. In other words, intermodality "is a subset of multimodality" (Nobis, 2007, p. 36). Co-modality refers to specific mobility services, such as ride-sharing, where a vehicle is used by several people, and can be used to further specify the intermodality and multimodality.

Taking a business perspective, we distinguish between MaaS and integration (which is one of its nine core characteristics (Jittrapirom et al., 2017)). In terms of new business opportunities created by digitalization, MaaS represents a new "mobility distribution model" (Caiati et al., 2020, p. 124) for complementary and competing mobility services (Schikofsky et al., 2020) that takes into account the individual preferences of customers (e.g., Caiati et al., 2020; Schikofsky et al., 2020). In addition, MaaS is characterized, among others, by the use of technologies, such as different devices (e.g., smartphones), an electronic ticketing system, and the Internet of Things. A further core characteristic is the digital platform (app or website) on which MaaS relies, and that customers can use to access a number of related service such as trip planning, booking, payment, and real-time information (Jittrapirom et al., 2017). MaaS can support a shift from monomodal to multimodal or intermodal mobility behavior by increasing the convenience of using multiple mobility services.

Operators of the digital platform can be public transport companies, public authorities, and third parties (Docherty et al., 2018; Jittrapirom et al., 2017). Collaboration among different actors via the digital platform leads to the emergence of new and to changes to established actor roles (Docherty et al., 2018; Smith et al., 2020), and to the formation of a service ecosystem around the operator (Jittrapirom et al., 2017). Integration is a task or an activity that takes place on varying hierarchical levels, denoted as operational, informational, and transactional integration (booking, payment, and ticketing) (Lyons et al., 2020).

MaaS and the intermodal and multimodal mobility behavior that is supported by it, also represent a form of smart mobility. According to Docherty et al. (2018), smart mobility is a relatively broad concept which includes new user-generated content and user-centred information that is context specific, intelligent infrastructure, as well as electric and automated vehicles. In general, the term "'smart' has become a new buzzword to describe technological, economic and social developments fuelled by technologies that rely on sensors, big data, open data, new ways of connectivity and exchange of information (e.g., Internet of Things, RFID, and NFC) as well as abilities to infer and reason" (Gretzel et al., 2015, p. 179).

Furthermore, (smart) mobility is one of the dimensions of the smart city concept, which has gained attention in the recent past both in science and practice (Giffinger and Haindlmaier, 2010). Its most important goals are reducing air and noise pollution, reducing traffic jams, lowering transfer costs, and improving transfer speed (Benevolo et al., 2016). In summary, the concept of 'smart mobility' goes beyond generating economic value, highlighting the need to create social value (e.g., environmental sustainability, social participation of elderly). In this thesis, the IT-supported use of multiple mobility services for a trip from an origin to a destination constitutes the core of the smart mobility concept.

2.3 The Mobility Sector in Germany

With 83.2 million inhabitants, the German mobility market is the largest in Europe in terms of the number of potential customers (Eurostat, 2020). In addition, with a share of 4.7% (134.9 billion euros) on the gross domestic product, the automotive sector is the most important sector in Germany. Numerous well-known automotive manufacturers, such as Daimler AG and the BMW Group, have their headquarters in Germany and employ 880,000 people (Statistisches Bundesamt, 2019).

As in most developed countries, the mobility behavior of people living in Germany is characterized by the predominant use of the private car, which accounted for 75% of the total transport volume (in passenger kilometers) in 2017 (Follmer and Gruschwitz, 2019). At the same time, changes in mobility behavior are visible. For example, the number of trips made by public transport increased from 9.6 to 10.4 billion between 2011 and 2018 (Verband Deutscher Verkehrsunternehmen, 2019). The German mobility market can be regarded as a welfare market in that public authorities aim to satisfy the mobility needs of the entire population (e.g., pupils, workers, the elderly, rural dwellers) by providing public transport (public transport as public good).

Public authorities often directly govern the provision of public transport by acting as a shareholder of a public transport company, and/or as a procurer of public transport as a member of a transport and tariff association. In Germany, transport and tariff associations are often responsible for the planning and marketing of public transport in a local geographical area and serve 85% of the population (Buehler et al., 2019). In the past, in the case of bus services, public authorities were able to reduce subsidy payments and to improve the quality of the services by introducing competitive tendering (Beck, 2011), but in 2017, German public transport companies ran losses of 3.45 billion euros (a cost recovery ratio of 75.6%), which were paid by public authorities (Verband Deutscher Verkehrsunternehmen, 2019).

Mobility services such as bike-, car- and ride-sharing have also gained in popularity as digitalization has made them more convenient to use. Car2go, the first-in-the-world free-floating car-sharing system, was launched by Daimler AG in Ulm in 2009 (Firnkorn and Müller, 2011). However, the share of sharing services in the overall mobility market is still very small. Currently, there are only 2.29 million car-sharing users in Germany (bsc Bundesverband CarSharing e.V., 2020), and only 2.5% of the surveyed internet users has used a bike-sharing service via an app or website in the last twelve months. In comparison, in China 37.4% of the internet users has done so (Statista, 2018). A recent survey of public transport users in the ten largest Germany cities found that 64% have never use a car- or ride-sharing service (Statista, 2019).

These results are in line with Burghard and Dütschke (2019), who reveal that there is a greater interest among non-car-sharing users to buy an electric vehicle instead of subscribing to electric car-sharing. Furthermore, they show that electric car-sharing is particularly attractive for the younger generation. In general, the younger generation is less emotionally attached to the private car, acquire their driving license at a later date, and is more open to app-based mobility services than older generations (Bratzel, 2018; Kuhnimhof et al., 2012; Umweltbundesamt, 2019). Studies from other developed countries, such as Great Britain, France, and the United States, provide similar results (Circella et al., 2017; Kuhnimhof et al., 2012; Rayle et al., 2014).

Several studies analyze the mobility behavior of German residents in more detail. Pfaff (2012) examined factors that lead people to decide to commute a distance of more than 50 kilometers between home and work instead of moving. His results show, among others, that the tendency to commute decreases with age, and increases with income and residence outside of metropolitan regions. Gross and Grimm (2018) studied the choice of public transport at vacation destinations, and identify different socio-demographic (e.g., age, net household income) and travel-oriented (travel duration, travel expenses, etc.) determinants. Sarker et al. (2020) analyze the walking distance to public transport stations and the perceptions of urban citizens on route choice. Their results show that about 57% of the survey participants choose the same route to the station nearly every day, and that 75% of the participants put a focus on the shortest distance.

In the urban context, Schoenau and Müller (2017) identify intrinsic (e.g., perceived behavioral control) and extrinsic factors (e.g., external costs) that influence mobility behavior of citizens.

Although the mobility behavior of people living in Germany is increasingly understood and actions have been taken to reduce dependency on the private car, the related challenges remain largely unsolved. An example are traffic jams and the associated costs for the national economy, such as loss of working time and the cost of fuel. According to the calculations of INRIX (2020), German car drivers spent on average over 46 hours waiting in traffic in 2019. As a result, in the ten most densely trafficked cities, including Berlin, Munich, and Stuttgart, congestion cost (measured by loss of time) of more than 2.8 billion euros were caused in 2019 (INRIX, 2020). In addition, among others, traffic jams contribute to an increase in the energy consumption of transport (in particular in the form of fuels) in the period between 2010 and 2017 (Umweltbundesamt, 2020b).

Another example for a negative consequence of the predominant private car use is the air pollution, which affects the health and well-being of the population and the environment. The mobility sector was the second largest emitter of greenhouse gases in Germany in 2018 with a share of 19% on the total volume (Umweltbundesamt, 2020a). 13,000 deaths in Germany, and 385,000 deaths worldwide, in 2015, can be attributed to these greenhouse gas emissions (Anenberg et al., 2019). German cities have taken various actions to reduce private car use, including the promotion of cycling, parking management, and improved convenience of public transport (Buehler et al., 2017). In addition, German courts have banned diesel vehicles from some areas of several cities in order to reduce air pollution. Despite investments in hybrid and electric car engines the number of electric cars in use in Germany (136,600, 2019) is still very low (Statista, 2020). One reason why the overall change in mobility behavior is relatively small could be that 60% of German citizens are 25 years old or older (Statistische Ämter des Bundes und der Länder, 2018), and older generations are less likely to adopt new mobility behaviors than younger generations (Bratzel, 2018; Kuhnimhof et al., 2012; Umweltbundesamt, 2019).

The Münchner Kreis e.V. (2017) has identified nine fields, such as 'mobility data as currency' (with a focus on ownership, transparency, and value creation) and 'a mobility marketplace in real-time', that need to be addressed with regard to future mobility. On the whole, the conditions for realizing alternatives to private car-dependent mobility are met well in Europe, especially in Germany. Two of the reasons are the high public pressure and pre-existing infrastructure (Marx et al., 2015; Willing et al., 2017b). Possibly as a result, projects aiming to replace private car use with a use of a combination of mobility services for a trip from an origin to a destination are most common in Europe.

Two of the first and best known projects are Whim (Helsinki, Finland) and UbiGo (Gothenburg, Sweden) (Lyons et al., 2020). These and other projects follow somewhat different approaches. Some focus on the provision of an app or a website that provides a convenient combination of mobility services, while others additionally focus on improving transport infrastructure (e.g., construction of bike-sharing stations). Albrecht and Ehmke (2016) and Willing et al. (2017a; 2017b) provide a comparison of apps and websites that are available for smart mobility in German-speaking European countries. Two of the best known apps for smart mobility – Reach Now (Daimler AG and the BMW Group) and Qixxit (Deutsche Bahn AG) – are offered by long-established companies already active in the mobility market. However, some start-ups and private persons also provide apps and websites for smart mobility.

2.4 Service-Dominant Logic Perspective

The service-dominant (S-D) logic perspective was introduced into marketing by Vargo and Lusch (2004) as a conceptual counterpart to the goods-dominant (G-D) logic perspective that was commonly adopted in science and practice up until then. It is now well established in a number of research fields, including public administration, service science, and tourism. It's three core concepts include service ecosystem, service platform, and value co-creation (for an overview, see Vargo and Lusch, 2017). Brust et al.'s (2017) literature review of the use of the S-D logic perspective, among others, identified no IS studies in a mobility context taking this perspective prior to their study. Subsequent IS studies applying the S-D logic perspective in the mobility context include Gilsing et al. (2018), Hein et al. (2018) and Turetken et al. (2019).

The S-D logic perspective is a suitable theoretical lens for this thesis because the intended shift of mobility behavior from the use of the private car to the use of a combination of multiple mobility services for a trip from an origin to a destination reflects a shift from G-D logic to S-D logic. Gilsing et al. (2018, p. 2) also pointed out to this fact, stating "smart mobility initiatives are shifting from a goods-dominant towards a service-dominant perspective, focusing explicitly on how the offered service solution creates value to the end-user […]. Emerging trends in the mobility domain like car sharing show that customers increasingly move away from a goods-dominant perspective (e.g. buying a car) but rather look at the value (e.g., the flexibility and ease-of-use) offered by car sharing applications that provide a similar mode of transportation".

Nonetheless, the application of the S-D logic perspective is linked to some limitations that constrain the generation of new contributions to theory and practice. One of the most important limitations is that the S-D logic perspective is, by nature, situated at the meta-theoretical level. As a consequence, direct testing, verification, and application is difficult. This may explain why much extant research taking the S-D logic perspective is conceptual. Future research should therefore focus on the midrange-theoretical and micro-theoretical level of abstraction. Furthermore, in further developing the S-D logic perspective, Vargo and Lusch (2017) suggest using complementary theories and concepts outside of marketing.

Scholars who take the S-D logic perspective focus on one or more of its three main concepts: (1) service ecosystem, (2) service platform, and (3) value co-creation (Hein et al., 2018; Lusch and Nambisan, 2015). A **service ecosystem** represents an actor-to-actor network and is defined as "a relatively self-contained, self-adjusting system of mostly loosely coupled social and economic (resource-integrating) actors connected by shared institutional logics and mutual value creation through service exchange" (Lusch and Nambisan, 2015, p. 161). Following this definition, individual households, companies, nations, and global markets are examples of service ecosystems (Koskela-Huotari et al., 2016). As these examples illustrate, actors are embedded in several service ecosystems (Akaka et al., 2013) and the boundaries of a service ecosystem are fluid. The analysis therefore requires zooming in and out to take into account the context on the micro (dyads), meso (triads), and macro (complex networks) level of context, a process Chandler and Vargo (2011, p. 41) call "oscillating foci".

Shared institutional logics, or synonymously, shared institutional arrangements (collections of interrelated institutions) (Lusch and Nambisan, 2015), represent the rules, norms, and beliefs of the actors that govern their service exchange within and between service ecosystems. In other words, they represent coordination mechanisms (rules of the game) that enable but also constrain service exchange (Akaka et al., 2013; Koskela-Huotari et al., 2016; Vargo and Lusch, 2017). Accordingly, new forms of resource integration and service exchange can be established by "breaking, making, and maintaining" of institutional arrangements (Koskela-Huotari et al., 2016, p. 2964). Altogether, the research concerning institutional arrangements is however still in its infancy. Vargo and Lusch (2017, p. 50) proposed several research questions worthy of investigation, such as "How do service ecosystems adapt and evolve?", "How do keystone actors in an ecosystem establish their position?", and "What are the institutions and institutional arrangements that allow service ecosystems to hold together and function?".

A **service platform** is "a modular structure that consists of tangible and intangible components (resources) and facilitates the interaction of actors and resources (or resource bundles)" (Lusch and Nambisan, 2015, p. 162). Examples of a service platform are an app or website. Previous research (Albrecht and Ehmke, 2016; Willing et al., 2017a; 2017b) compares the various apps and websites that focus on the provision of smart mobility in German-speaking Europe, but without explicitly adopting the S-D logic perspective. By using a service platform to decouple information from its physical representation and make it sharable among service ecosystem actors, a process Lusch and Nambisan (2015) and Hein et al. (2018) refer to as 'resource liquefication', and to increase resource density, the actors of a service ecosystem can make their service exchange more efficient and effective. As Storbacka (2019, p. 6) describes, "density expresses the degree to which resources are accessible for integration in a specific actor, time, situation and space combination. Digitalization liquifies resources […], allowing them to be easily moved about in time and space, thus creating an abundance of opportunities for linking resources between actors in new ways".

Value co-creation represents the resource integration and service exchange by an actor in a service ecosystem (Vargo and Lusch, 2017). With regard to the resource integration, operand resources, which are defined as "resources on which an operation or act is performed" (e.g., animal life, land, minerals, data) and operant resources that "are employed to act on operand resources" (e.g., capabilities, competences, knowledge, and skills) can be distinguished (Vargo and Lusch, 2004, p. 2). New opportunities for value co-creation arise particularly in the case of technological breakthroughs, such as the development and dissemination of smartphones and sensors, and changes in the industrial logic, as it currently occurs in the mobility sector (Payne et al., 2008).

Currently, however, the scientific knowledge about IT-enabled value co-creation is very limited (Breidbach and Maglio, 2016). An important difference to the G-D logic is that beneficiaries (i.e., customers) also engage in value co-creation (Vargo and Lusch, 2017). Nunes et al. (2014) emphasized that a customer can, for example, actively or passively provide information on how crowded a bus or train is by using his or her smartphone and a smart mobility app. In turn, this information can be used to provide higher-quality recommendations to other customers. This example illustrates the assumption of the S-D logic perspective "that value is fundamentally derived and determined in use – the integration and application of resources in a specific context – rather than in exchange – embedded in firm output [such as cars] and captured by price" (Vargo et al., 2008, p. 145). In other words, the principle of value-in-exchange (G-D logic) is replaced by the principle of value-in-use (Vargo and Lusch, 2004), and, more recently, by value-in-context (Chandler and Vargo, 2011; Vargo and Lusch, 2017; Vargo et al., 2008).

In practice, however, value co-creation is difficult to observe empirically. Storbacka et al. (2016, p. 3008) propose treating actor engagement as a microfoundation, which is defined as "both the actor's disposition to engage, and the activity of engaging in an interactive process of resource integration within a service ecosystem". In this vein, Alexander et al. (2017, p. 341) highlight that actor engagement is an important midrange concept and that balancing of multiple roles can lead to disengagement behavior of actors due to role conflicts: "When actors engage with multiple institutions simultaneously, they face demands, requirements and responsibilities deriving from the institutions and institutional arrangements particular to each context. In this section, circumstances when actors may experience contextual pressures or conflict are considered that may affect their propensity to engage". Table 4 summarizes the five core foundational premises of the S-D logic perspective.

No.	Axiom
1	Service is the fundamental basis of exchange
2	Value is cocreated by multiple actors, always including the beneficiary
3	All social and economic actors are resource integrators
4	Value is always uniquely and phenomenologically determined by the beneficiary
5	Value cocreation is coordinated through actor-generated institutions and institutional arrangements

Table 4. The Axioms of S-D Logic (Vargo and Lusch, 2017, p. 47).

3 Mixed Methods Research Design

To answer our research questions, we chose a mixed methods research design, which is defined as “the sequential or concurrent combination of quantitative and qualitative methods (e.g., data collection, analysis and presentation) within a single research inquiry” (Venkatesh et al., 2013, p. 24). Table 5 provides an overview of the qualitative and quantitative methods that are used in this thesis.

No.	Title	Literature review	Expert interviews	Case study research	Conjoint analysis	QCA
P1	Door-to-Door Mobility Integrators as Keystone Organizations of Smart Ecosystems: Resources and Value Co-Creation – A Literature Review	●				
P2	Smart Mobility – An Analysis of Potential Customers’ Preference Structures	○	○	○	●	
P3	The Long and Winding Road to Smart Integration of Door-to-Door Mobility Services: An Analysis of the Hindering Influence of Intra-Role Conflicts	○	●			
P4	How Institutional Arrangements Impede Realization of Smart Ecosystems: The Case of Door-To-Door Mobility Integrators	○	●			
P5	How Countervailing Power Affects Value Co-Creation among Service Providers: A Comparison of the Travel and Mobility Sectors	○	●			
P6	Information Technology Choice in Mobility Service Ecosystems: A Qualitative Comparative Analysis	○	○			●
P7	Smart Mobility: Contradictions in Value Co-Creation	○	●			
P8	The Negative Effects of Institutional Logic Multiplicity on Service Platforms in Intermodal Mobility Ecosystems	○	●	○		
P9	Value Co-Creation and Co-Destruction in Service Ecosystems: The Case of the Reach Now App	○	○	●		
● Primary method ○ Complementary method						

Table 5. Overview of the Methods used in the Embedded Publications.

Venkatesh et al. (2013) identify seven purposes of mixed methods research – complementarity, completeness, developmental, expansion, corroboration/confirmation, compensation, and diversity – at least one of which must be present to justify such an approach. For example, the developmental purpose is defined as follows: “Questions for one strand emerge from the inferences of a previous one (sequential mixed methods), or one strand provides hypotheses to be tested in the next one” (Venkatesh et al., 2013, p. 26). For instance, P2, in which an analysis of customer reviews, an expert interview, and a conjoint analysis is conducted, corresponds to this definition. In addition, purposes such as complementarity, expansion, and diversity are present in this research inquiry. In other words, the use of a mixed methods research design is justified.

As can be seen from the example, the use of quantitative and qualitative methods can compensate for the weaknesses of each method, and thus improve the quality of the results. While the analysis of customer reviews aims to obtain as complete picture as possible of all relevant attributes and attribute levels of a smart mobility app, the focus of the conjoint analysis is on determining statistically significant differences in the preference structures of potential groups of customers (whose focus is on the six most important attributes and their attribute levels).

Regardless of the different strengths and weaknesses of quantitative and qualitative methods, and the possibility to offset their limitations through a combination (Venkatesh et al., 2013), the question arises whether both methods can be combined due to varying paradigms. A paradigm is defined as “a worldview, together with the various philosophical assumptions associated with that point of view” (Teddlie and Tashakkori, 2009, p. 84), and examples are (post) positivism, constructivism, and interpretivism (e.g., Feilzer, 2010; Hall, 2013; Morgan, 2007; Teddlie and Tashakkori, 2009). In the past, several scholars have highlighted the advantages and disadvantages of both methods that originate from their underlying paradigms. Feilzer (2010, p. 6) and Maxwell and Mittapalli (2010, p. 146) also spoke of paradigm “wars” in this context that exist between the (post) positivism and constructivism/interpretivism paradigms (Goldkuhl, 2012; Morgan, 2007).

Quantitative research is usually based on the paradigm of (post) positivism, which is characterized, in particular, by the “notion of a singular reality, the one and only truth that is out there waiting to be discovered by objective and value-free inquiry” (Feilzer, 2010, p. 6). In contrast, qualitative research is underpinned by the paradigm of constructivism that denies the existence of an objective reality, and therefore assumes that only subjective inquiries are possible (Feilzer, 2010; Hall, 2013; Kaushik and Walsh, 2019).

In order to bridge the paradigm gap that underlies quantitative and qualitative research methods, three approaches have been discussed in the mixed methods literature (Hall, 2013): (1) Some scholars opt to simply ignore paradigmatic issues (a-paradigmatic stance). However, this approach has been criticized because “no research is paradigm free” (Hall, 2013, p. 75); (2) the second approach assumes that the alternative paradigms are not incompatible and can be used in a single research inquiry (multiple paradigm stance); and (3) the last approach is based on the assumption that quantitative and qualitative research can be conducted under a single paradigm (single paradigm stance), such as realism (e.g., Maxwell and Mittapalli, 2010; Venkatesh et al., 2013) and pragmatism (Feilzer, 2010; Morgan, 2007; Teddlie and Tashakkori, 2009; Venkatesh et al., 2013, etc.).

In this thesis, we choose pragmatism as the paradigm most commonly linked with mixed methods research (Kaushik and Walsh, 2019; Teddlie and Tashakkori, 2009), but is also applied in single method research designs (Feilzer, 2010; Goldkuhl, 2012; Kaushik and Walsh, 2019). The paradigm of pragmatism “sidesteps the contentious issues of truth and reality, accepts, philosophically, that there are singular and multiple realities that are open to empirical inquiry and orients itself toward solving practical problems in the 'real world'" (Feilzer, 2010, p. 8; see also Kaushik and Walsh, 2019). This focus on real world problems fits well with the aim to solve the challenges caused by the predominant use of the private car by establishing functional service ecosystems for smart mobility.

Morgan (2014) described the pragmatist research approach by using a five-step model: (1) The researcher recognizes a certain research problem that is defined as a situation, which is beyond the range of its experiences. As a result, he or she has no line of action to address it (i.e., formulation of a research question); (2) The researcher thinks through the research problem and searches for a possible solution. This reflection on the choice of the research problem is based on her/his beliefs and can lead to the reformulation of the research question; (3) The result of the problem reflection is a suggested solution (i.e., a potential research design) that consists of a set of actions. In some cases, a new version of the research problem is developed. This iterative approach is referred to as 'abductive reasoning' (Venkatesh et al., 2013), "which is based on a kind of if-then relationship" (Kaushik and Walsh, 2019, p. 8), and reflects the idea that "if you act in a particular way, then you are likely produce a specific set of outcomes" (Morgan, 2014, p. 29); (4) The researcher reflects on the effects of the tentative solution (i.e., of the choice of research methods). This reflection may lead the researcher to reconsider the research design; and (5) The researcher is taking action (i.e., conducting research). If necessary, he or she develops a new solution to the problem.

In summary, Venkatesh et al. (2013, p. 22) "suggest that if a mixed methods approach helps a researcher find theoretically plausible answers to his or her research questions and if the researcher is able to overcome the cognitive and practical barriers associated with conducting mixed methods research, he or she should undertake such research without much consideration of paradigmatic or cultural incommensurability". In the following, the individual quantitative and qualitative methods used in P1 to P9 are described briefly.

3.1 Literature Review

A literature review constitutes the foundation of any research endeavor, because "to advance our collective understanding, a researcher or scholar needs to understand what has been done before, the strengths and weaknesses of existing studies, and what they might mean. A researcher cannot perform significant research without first understanding the literature in the field" (Boote and Beile, 2005, p. 3). Writing a literature review serves a number of purposes, such as synthesizing existing work and gaining a new perspective, and outlining the historical context of the research (e.g., Hart, 1998).

Several research methods, such as meta-analysis, descriptive literature review, and bibliometric analysis, can be used to conduct a literature review (Raghuram et al., 2010). According to the taxonomy provided by Cooper (1988), a literature review can be classified on the basis of its focus, goal, perspective, coverage, organization, and audience. A number of scholars have provided guidelines on how to conduct a literature review (e.g., vom Brocke et al., 2009).

One of the most frequently applied guidelines in the IS field are those provided by Webster and Watson (2002). The process of identifying relevant publications comprises three steps: (1) The leading scientific journals of an academic field are searched for relevant publications (e.g., the

Senior Scholars' Basket of Journals of the Association for Information Systems), as these probably contain the most important contributions. Since the IS field, as well as the topic of smart mobility, is interdisciplinary in nature, publications in other fields should also be considered. For the selection of relevant publications a keyword search can be conducted or the table of contents of the journals can be reviewed. In addition, publications at scientific conferences, in particular those with highly competitive admittance criteria, and publications included in databases should be taken into account; (2) On the basis of the selected publications, a backward search is performed, in which publications cited in the selected publications are analyzed for their contribution; and (3) A forward search is conducted to identify and check publications which cite selected publications.

To analyze the selected publications and structure the results, a concept-centric approach is preferable over an author-centric approach. Following a concept-centric approach, the most important concepts are identified across the publications, frequently using a concept matrix.

In P1, we conduct a literature review to gain insights into the operand and operant resources (and possible constraints) that underlie the value co-creation of smart mobility app providers. In addition, a literature review is performed as a complementary method in P2 to P9 to identify research gaps and anchor the empirical studies in existing scientific knowledge.

3.2 Expert Interviews

Qualitative data is very often collected by conducting interviews (Myers and Newman, 2007). Expert interviews are defined on the basis of their object, namely the expert (Bogner et al., 2009), which is characterized as "someone who is skilful and well-informed in some special field" (Ericsson, 2006; Mauksch et al., 2020, p. 2). According to Mauksch et al. (2020), the assignment of the status of expert varies depending on whether a sociological (e.g., persons who speak on behalf of a company), behavioral (e.g., focus on how people make choices under uncertainty), or cognitive perspective (e.g., expertise due to domain-specific training and practice) is taken in assessing expertise.

The advantages of performing expert interviews include efficient data collection – "experts are seen as 'crystallization points' for practical insider knowledge" (Bogner et al., 2009, p. 2), and getting access to a field that would otherwise be difficult or impossible to obtain. While, among others, lack of trust in the interviewer, an elite bias, and the so-called Hawthorne effect represent potential risks (Bogner et al., 2009; Myers and Newman, 2007). In identifying and acquiring experts, a snowball sampling approach can be used, in which interviewees recommend further experts and possibly support their acquisition, for instance, by providing contact data (Bogner et al., 2009; Myers and Newman, 2007).

According to Myers and Newman (2007), conducting an interview can be compared with performing a drama (with, for example, a stage, props, and a script). In a business context, usually an office represents the stage and the tape recorder is one of the props. The interviewer and the interviewee are the actors. The researcher plays an interested interviewer, while the interviewee plays a knowledgeable person of an organization. The interview guideline represents the script and guides the conversation based on the questions. In general, three types of guidelines and interviews, respectively, can be distinguished: unstructured, semi-structured, and structured.

The interviewer and the interviewee also represent the audience. The researcher should carefully listen to the explanation of the expert, while the expert should listen to the questions and answer them appropriately.

The unstructured and semi-structured interview are most frequently used in qualitative research in the IS field (Myers and Newman, 2007). Semi-structured interviews are based on an (incomplete) interview guideline and allow the interviewer some degree of freedom and improvisation in conducting the interviews. As a result, a semi-structured interview is more like a natural conversation, in that the order of questions is not fixed and the interviewer asks questions and responds to new facts that come to light during the interview (Flick, 2009; Myers and Newman, 2007). Subsequent to the interview, the recording is transcribed and evaluated. For detailed insights into the process of interview data analysis see Flick (2009) and Myers (2020).

Interviews with experts, such as managing directors of mobility providers, of smart mobility app providers, and responsible persons of public authorities (e.g., city and region administration) form the data basis for P2 to P9.

3.3 Case Study Research

"A case study examines a phenomenon in its natural setting, employing multiple methods of data collection to gather information from one or a few entities (people, groups, or organizations). The boundaries of the phenomenon are not clearly evident at the outset of the research and no experimental control or manipulation is used" (Benbasat et al., 1987, p. 370). The data sources include, among others, interviews, observations, archival data, and questionnaires (Eisenhardt, 1989). In the following, the different phases for conducting a case study research as suggested by Yin (2018) are briefly described:

In the **starting phase**, scholars need to evaluate whether the choice of a case study approach is appropriate. According to Benbasat et al. (1987), four criteria can be used for the evaluation: A case study is useful (1) if the phenomenon of interest needs to be studied in its natural setting, or (2) if the focus of the analysis is on contemporary events. In addition, (3) it is useful to conduct a case study if there is no strong theoretical basis with regard to the phenomenon of interest. On the other hand, (4) case study research is not suitable if there is a need to manipulate or to control the subjects or events. Stake (1994) identifies characteristics that make a case and its results uncommon, including the nature of the case, its historical background, its physical setting, its context (e.g., economic, political, and legal), previous cases that contribute to its recognition, and access to informants.

In the **design phase**, scholars must determine the research design that includes the research question(s) of the study, its propositions (if any), its case(s), the logic that links the data to the propositions, and the criteria for the interpretation of the results (Yin, 2018). It is important to make sure that the research question is suitable for a case study research (i.e., formulation of 'how' and 'why' questions) (Benbasat et al., 1987; Yin, 2018). The research question should aim at closing a research gap that can be identified on the basis of a literature review. By formulating theoretical propositions, data collection can be facilitated because these provide clues "where to look for relevant evidence" (Yin, 2018, p. 28). However, it is also possible to carry out an exploratory study. Despite the lack of theoretical propositions, the research should always have a specific purpose on that can be draw to evaluate the success of a study (Yin, 2018). On the basis of the research question and, if applicable, the theoretical propositions, the case(s) is defined. Examples are individuals, groups or an organization (Benbasat et al., 1987). In total, there are four possible basic types of designs for case studies, which differ in terms of the number of cases (single or multiple case designs) and of the number of units of analysis (single unit or multiple units of analysis) (Yin, 2018).

In the **preparation phase** the data collection is planned and prepared (Yin, 2018). This includes choices about which persons should be interviewed, and which places and events should be observed (Stake, 1994). Exemplary tasks in this phase are the screening of candidate cases, the acquisition of interviewees, the development of an interview guideline, and the execution of a pilot case study (Yin, 2018). Recommendations for the preparation of an interview guideline are, for example, provided by Gläser and Laudel (2010) and Merton and Kendall (1946).

In the **collection phase** a variety of data from multiple data sources should be gathered in order to provide a "stronger substantiation of constructs and hypotheses" by executing data triangulation (Benbasat et al., 1987; Eisenhardt, 1989, p. 538; Stake, 1994; Yin, 2018). According to Eisenhardt (1989), the most common data sources are archival data (written documents and records) (Hodder, 1994), interviews (Fontana and Frey, 1994), and observations (Adler and Adler, 1994).

In the **analysis phase,** four general analytic strategies are available for the analysis of the collected data: (1) the theoretical propositions guide the data analysis and point to contextual conditions that must be described; (2) the theoretical propositions are neglected during the data analysis. Instead, scholars focus on the collected data in order to identify useful concept(s) and relationships; (3) a case description is developed, which allows the case study analysis to be organized according to a descriptive framework; and (4) plausible rival explanations are defined and checked. This analytic strategy can be combined with each of the other strategies (Yin, 2018).

In the **reporting phase**, conclusions drawn from the case study are shared. It is important to present the results in line with the preferences of the target group (e.g., with regard to details and length). For instance, providing an overview on the chosen analytic strategy can help readers better assess the quality of the results and a description of the case helps readers better understand the context of the case study (e.g., similarities and differences compared to other cases) (Stake, 1994; Yin, 2018).

In P9, we adopted a holistic single case design to study value formation (i.e., value co-creation and value co-destruction) among different actors embedded in the service ecosystem in the case of the Reach Now app. More precisely, relying on customer reviews and interview data, we analyzed the value formation in the dyadic actor-to-actor relationships between the Moovel Group GmbH (the smart mobility app provider) and its customers, as well as between the Moovel Group GmbH and relevant transport and tariff associations, and how the value formations are linked.

3.4 Conjoint Analysis

The conjoint analysis is a method of predicting people's choice decisions, especially of potential customers, based on an evaluation of their preference structures. The theoretical foundations for conjoint analysis were developed in the field of psychology (Luce and Tukey, 1964). Over the years, conjoint analysis has been continuously developed and many subsequent variants have been developed and affirmed (Hair Jr. et al., 2014). In the most common variant, the so-called preference-based conjoint analysis or traditional conjoint analysis (TCA), study participants are presented with a number of artificially constructed products or services which they rank or rate based on their preferences (Backhaus et al., 2015).

A disadvantage of both evaluation approaches is that they require high mental effort on the part of participants, so results often do not correspond to their actual preferences (Berger et al., 2015). In order to determine the preference structures more precisely, and thus to better mimic the choice decision of the participants, discrete choice analysis can be conducted (Backhaus et al., 2015). For this reason, the choice-based conjoint (CBC) analysis is the most frequently applied variant of the conjoint analysis (Sattler and Hartmann, 2008). Naous and Legner (2017) provide an overview of the use of conjoint analysis in IS research.

The CBC analysis is based on several assumptions (Backhaus et al., 2015; Hair Jr. et al., 2014), one of the most important is that the value of an attribute, respectively of its attribute levels, can be determined on the basis on the evaluation of a whole product or service (decompositional approach). Implementing and conducting a CBC analysis comprises seven steps, which are described in Backhaus et al. (2015) in more detail. According to Hair Jr. et al. (2014), no more than six attributes should be considered in order to limit the complexity for participants. The attribute 'price' is always included in a CBC analysis involving willingness to pay for a product or service.

In determining the attribute levels of an attribute, it is important that "the range (low to high) of the [attribute] levels [is] set somewhat outside existing values but not at an unbelievable level" (Hair Jr. et al., 2014, p. 363). During a CBC analysis, the participants are asked to make several choice decisions among several products or services presented to them (choice sets). In order to ensure the reliability and validity of the results, two identical choice sets (so-called 'holdouts') should be implemented (Backhaus et al., 2015; Hair Jr. et al., 2014).

The analysis of the gathered empirical data is performed as follows: Initially, based on the observed choice decisions of the participants, a part-worth is calculated for each attribute level. The totality of these part-worths reflects the preference structure of the participants (Berger et al., 2015). The importance of each attribute is determined by calculating the difference between the highest and the lowest part-worth of its attribute levels. If the difference is set in relation to the sum of the differences from all attributes, the relative importance of the attribute is determined (Backhaus et al., 2015). Based on this, the total value of a specific product or service can be calculated by adding up the part-worths of the attribute levels present (Hair Jr. et al., 2014). Taking this calculation approach, the part-worths of the present attribute levels can be in a compensatory relationship (Berger et al., 2015). Finally, the choice decisions of the participants can be predicted on the basis of the calculated total value for each of the products or services presented in the choice sets (Backhaus et al., 2015).

In P2, we conducted a CBC analysis to determine the preference structures of several groups of potential customers for a smart mobility app. In order to identify and select the attributes and their attribute levels, two preliminary studies were carried out, in which customer reviews for available smart mobility apps were analyzed, and interviews with potential customers and an expert from the mobility sector were conducted.

3.5 Qualitative Comparative Analysis (QCA)

Qualitative comparative analysis (QCA), and the fuzzy-set qualitative comparative analysis (fsQCA), have their origins in sociology and political science (Schneider and Wagemann, 2007), but have in the meantime gained some popularity in other scientific fields, including IS (for an overview, see Soto Setzke et al., 2020; Zimmermann et al., 2020) and service science (e.g., Ordanini et al., 2014). A special characteristic of QCA, and respectively fsQCA, is that the "analysis focuses on set relations rather than on correlations" (Rivard and Lapointe, 2012, p. 901). This is an important difference to traditional regressions-based models, where the net effect of each factor on the outcome is determined. Further characteristics are the concept of equifinality, which means that varying causal sets can lead to the same outcome, as well as the assumption that the relationships between the attribute levels and the outcome need not be symmetrical. This means that, in contrast to traditional regressions-based models, where a factor is a necessary and a sufficient condition for an outcome, an attribute level may be a necessary or a sufficient condition for an outcome (Soto Setzke et al., 2020).

Schneider and Wagemann (2007) recommended a medium number of cases (from 10 to 50) as a basis for conducting QCA and fsQCA. Deviating from this recommendation, the literature review provided by Soto Setzke et al. (2020) showed that IS studies mainly draw on a large number of cases (50+), which limits some of the key capabilities of QCA and fsQCA. Due to the focus on a medium number of cases, the aim is often not on the generalizability of the results, instead "a combination of 'positive cases' that display the outcome and 'negative cases' that could be expected to display the outcome but do not" (Greckhamer et al., 2018, p. 488) is chosen for analysis.

According to Fiss (2011) and Ordanini et al. (2014), fsQCA comprises four steps: (1) Based on extant theoretical knowledge, the property space is defined, which includes all theoretically possible configurations of attribute levels. In general, it is assumed that each attribute has only two attribute levels (present or not present); (2) the set-membership measures are developed. A set is a configuration of attribute levels and is illustrated in a binary format. In practice, empirical data is, however, often not dichotomous, which is why, besides a crisp set (1 = 'fully in', and 0 = 'fully out'), for example, a four-value fuzzy set (1 = 'fully in', 0.67 = 'more in than out', 0.33 = 'more out than in', and 0 = 'fully out') can be used (Rihoux and Ragin, 2009). One of these membership scores is assigned to each attribute of each empirical case; (3) the consistency is evaluated. An attribute level is a necessary condition if its consistency measure exceeds a threshold of 0.9 (Schneider and Wagemann, 2007). In addition, a cross-case comparison between the causal sets and the outcome set needs to be conducted in order to evaluate the consistency in set relations and to determine the sufficient conditions. Ragin (2008) and Rihoux and Ragin (2009) recommended a threshold of 0.75; (4) by performing a logical reduction, it is possible "to prune the sufficient configurations by eliminating redundant elements" (Ordanini et al., 2014, p. 139). It must be determined how to deal with so-called 'remainders', which are sets that are not present in the empirical data.

In IS studies, the fs/QCA software is most frequently used (Soto Setzke et al., 2020), which is based on the Quine-McCluskey algorithm (Schneider and Wagemann, 2007). The quality of the results can be assessed on the basis of the consistency of and coverage of the solution. The quality of the solution can be regarded as high if the value of the solution consistency is between 0.75 and 1.00. In addition, a value for the coverage below 0.46 can be considered rather low (Soto Setzke et al., 2020).

In P6, we conducted an fsQCA to examine the IT choice of transport and tariff associations based on interview and secondary data. The IT choice, in turn, strongly influences their disposition to engage in value co-creation with a smart mobility app provider.

Part B

4 Door-to-Door Mobility Integrators as Keystone Organizations of Smart Ecosystems: Resources and Value Co-Creation – A Literature Review (P1)

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Publication	International Conference on Wirtschaftsinformatik (WI), 2019
Status	Published
Contribution of first author	Problem definition, research design, literature search and analysis, interpretation, reporting

Table 6. Fact Sheet Publication P1.

Abstract

Cities around the world face major mobility-related challenges, such as traffic congestion and air pollution. One primary cause of these challenges is the decision of citizens to use their private car instead of alternative mobility services such as public transport, car-sharing and bike-sharing. Technological progress offers new possibilities to address these challenges by making alternative mobility services easier and more convenient to use. This paper focuses on door-to-door (D2D) mobility integrators, which aim to offer citizens seamless D2D transport by packaging alternative mobility services. To better understand the practical barriers D2D mobility integrators face, this interdisciplinary literature review provides a holistic picture of their operand and operant resources, revealing significant gaps in our understanding of their capability to attract actors to their ecosystem and to manage value co-creation. Based on these gaps, we identify a potential avenue of future research.

Keywords: D2D Mobility Integrators, Literature Review, Operand Resources, Operant Resources, Value Co-Creation.

5 Smart Mobility – An Analysis of Potential Customers' Preference Structures (P2)[1,2]

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Publication	Electronic Markets (EM), 2021
Status	Published
Contribution of first author	Problem definition, research design, data collection and analysis, interpretation, reporting

Table 7. Fact Sheet Publication P2.

Abstract

Cities around the world face major challenges caused by the extensive use of private cars. To counteract these problems, a new paradigm is necessary which promotes alternative mobility services. 'Smart mobility' refers to a new mobility behaviour that makes use of innovative technical solutions, such as the IT-supported combination of different alternative mobility services during a trip from an origin to a destination. Unfortunately, relatively few customers use apps that provide recommendations for smart mobility and there is limited knowledge about the desires, priorities and needs of potential customers. To fill this gap, we use conjoint analysis to explore differences in smart mobility app preferences across groups of people with varying mobility behaviour. Our study also considers the effect of age and place of residence on preference structures. Our results show, for example, that only car drivers do not consider the price of the smart mobility app to be particularly important for their selection decision.

Keywords: Conjoint Analysis, Mobility as a Service (MaaS), Monetization, Preference Structure, Smart Mobility.

[2] Supplementary material is provided in the Appendix C.

6 The Long and Winding Road to Smart Integration of Door-to-Door Mobility Services: An Analysis of the Hindering Influence of Intra-Role Conflicts (P3)

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Publication	European Conference on Information Systems (ECIS), 2018
Status	Published
Contribution of first author	Problem definition, research design, data collection and analysis, interpretation, reporting

Table 8. Fact Sheet Publication P3.

Abstract

Technical advances such as sensors and open data have enabled service integrators to offer smarter service packages. Door-to-door (D2D) mobility integrators now promise to provide smart (i.e., highly individualized, dynamic, and context-aware) services by packaging component mobility services provided by independent mobility providers, such as bus, car-sharing and train companies. However, this business model has inherent conflicts. This research proposes a role framework for smart D2D mobility integrators and analyses intra-role conflicts to explain the low cooperation rate among public transport companies with D2D mobility integrators. Drawing on intermediary literature and role conflict theory, this study identifies how intra-role conflicts between D2D mobility integrators and transport and tariff associations (TTAs), the regional representations of public transport companies, lead to non-cooperation. Our empirical results from the German mobility sector show strong intra-role conflicts within the logistical and customization role. Especially the TTAs' desire to provide D2D mobility themselves negatively influence their willingness to cooperate.

Keywords: Business Model, Intermediary, Mobility Service, Smart.

7 How Institutional Arrangements Impede Realization of Smart Ecosystems: The Case of Door-To-Door Mobility Integrators (P4)

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Publication	European Conference on Information Systems (ECIS), 2018
Status	Published
Contribution of first author	Problem definition, research design, data analysis, interpretation, reporting

Table 9. Fact Sheet Publication P4.

Abstract

Technical progress has enabled companies to offer smart services. In the mobility sector, emerging door-to-door (D2D) mobility integrators promise to provide highly individualized, dynamic, and context-aware mobility service by bundling different mobility services, such as car-sharing and public transport. These D2D mobility integrators are well-positioned to facilitate access and use of non-private car-based mobility and thus to contribute to solutions to major challenges facing cities around the world, such as traffic congestion and air pollution. However, D2D mobility integrators struggle to attract mobility providers to their service ecosystem. This research applies the concept of legitimacy, which originates from institutional theory, and service-dominant (S-D) logic to analyse the current embeddedness of mobility providers in service ecosystems and the underlying institutional arrangements as a possible barrier to entering into a D2D mobility integrator service ecosystem. An exploratory study with German mobility providers was conducted. Our empirical results show that embeddedness in already existing service ecosystems, in particular, reduces their need to gain market legitimacy and for the legitimacy of the new type of smart cooperation. These lead to a lack of cooperation with D2D mobility integrators.

Keywords: Institutional Theory, Legitimacy, Service-Dominant Logic, Smart Mobility.

8 How Countervailing Power Affects Value Co-Creation among Service Providers: A Comparison of the Travel and Mobility Sectors (P5)

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Status	Published
Contribution of first author	Problem definition, research design, data analysis, interpretation, reporting

Table 10. Fact Sheet Publication P5.

Abstract

Customers often have complex needs that cannot be met by a single service provider. Service integrators and service providers can use information technology to establish service ecosystems in order to provide customers an all-in-one solution. In this paper, we examine why hotel organizations are more willing to engage in value co-creation with service integrators than public transport organizations. We take the service-dominant logic perspective, augmented by the concept of (countervailing) power. Interviews with representatives from 26 German hotel and public transport organizations reveal a trade-off between greater satisfaction of customer needs and a potential loss of power. In contrast to hotel organizations, the service ecosystems of public transport organizations are characterized by institutional arrangements that restrict their price and place policies, and thus negatively affect their ability to develop and maintain countervailing power. Practitioners can apply our findings to design beneficial institutional arrangements and thus facilitate value co-creation.

Keywords: Power Theory, Service-Dominant Logic, Service Integrators, Smart Mobility.

9 Information Technology Choice in Mobility Service Ecosystems: A Qualitative Comparative Analysis (P6)[3]

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Publication	International Conference on Information Systems (ICIS), 2020
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Contribution of first author	Problem definition, research design, data collection and analysis, interpretation, reporting

Table 11. Fact Sheet Publication P6.

Abstract

Cities around the globe face mobility-related challenges such as traffic congestion and air and noise pollution caused by the extensive use of private cars. Smart solutions promise to make urban mobility more intelligent, interconnected, and efficient using information technology (IT). This study analyzes IT choice in the service ecosystems of different German transport and tariff associations. Taking a service-dominant logic perspective, we apply fuzzy-set qualitative comparative analysis (fsQCA) in order to identify the configurations of attributes levels characterizing the actors and institutional arrangements of each service ecosystem that are linked to the choice of state-of-the-art IT. Our results reveal that the availability of a high number of car-sharing actors in the service ecosystem is a necessary condition for choosing state-of-the-art IT. Our study guides decision-makers in responding to mobility challenges caused by the predominant usage of the private car and thus contributes to the overarching goal of achieving livable cities.

Keywords: Information Technology Choice, Public Transport Service, Qualitative Comparative Analysis (QCA), Service-Dominant Logic, Smart Mobility.

[3] Supplementary material is provided in the Appendix H.

10 Smart Mobility: Contradictions in Value Co-Creation (P7)[4]

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Publication	Information Systems Frontiers, 2020
Status	Published (in press)
Contribution of first author	Problem definition, research design, data collection and analysis, interpretation, reporting

Table 12. Fact Sheet Publication P7.

Abstract

Technical progress is disrupting the mobility sector. New door-to-door (D2D) mobility integrators promise to offer smart mobility by packaging together different mobility services such as car-sharing and public transport. However, mobility providers up to now have rarely entered into value co-creation relationships. As a result, citizens are offered mobility that cannot be considered truly smart. Although value co-creation has been the subject of numerous studies taking the service-dominant logic perspective, this research has often lacked empirical evidence. To close this gap, we conceptualize value co-creation between mobility providers and a D2D mobility integrator by applying Activity Theory. Based on a qualitative study in the German mobility sector, we identify several inhibitors of value co-creation from the viewpoint of mobility providers. In addition, we show how these inhibitors serve as triggers for adaptations, ultimately leading to the formation of a value co-creation relationship.

Keywords: Activity Theory, Service-Dominant Logic, Smart Mobility, Value Co-Creation.

11 The Negative Effects of Institutional Logic Multiplicity on Service Platforms in Intermodal Mobility Ecosystems (P8)[5]

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Publication	Business & Information Systems Engineering (BISE), 2020
Status	Published
Contribution of first author	Problem definition, research design, data analysis, interpretation, reporting

Table 13. Fact Sheet Publication P8.

Abstract

Digitalization is changing the mobility sector. Companies have developed entirely new mobility services, and mobility services with pre-digital roots, such as ride-sharing and public transport, have leveraged digitalization to become more convenient to use. Nevertheless, private car use remains the dominant mode of transport in most developed countries, leading to problems such as delays due to traffic congestion, insufficient parking spaces, as well as noise and air pollution. Emerging intermodal mobility ecosystems take advantage of digital advances in mobility services by providing individual, dynamic and context-aware combinations of different mobility services to simplify door-to-door mobility and contribute to the reduction of private car use. However, the service platforms are limited in terms of functional range, for example they may lack integrated ticketing and rely on static data, which makes intermodal mobility inconvenient. This article adopts the service-dominant logic perspective to analyze service ecosystems for intermodal mobility and their service provision. Drawing on traditional institutional literature, the authors question the assumption that service logic is dominant for all actors of a service ecosystem. By applying activity theory, the article illustrates how an institutional logic multiplicity among actors can negatively affect the functional range of service platforms. The results of a qualitative study in Germany show that, in particular, the state logic of some actors, which is characterized by the obligation to provide mobility, impairs the quality of service platforms in supporting citizens in intermodal mobility.

Keywords: Intermodal Mobility, Logic Multiplicity, Service-Dominant Logic, Service Ecosystem.

12 Value Co-Creation and Co-Destruction in Service Ecosystems: The Case of the Reach Now App (P9)[6]

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Publication	Technological Forecasting & Social Change
Status	Published (in press)
Contribution of first author	Problem definition, research design, data collection and analysis, interpretation, reporting

Table 14. Fact Sheet Publication P9.

Abstract

In recent years, a change in business logic from goods-dominant (G-D) to service-dominant (S-D) logic can be observed widely. For instance, in the case of the mobility sector, companies such as Daimler AG and the BMW Group are shifting from solely producing cars to also providing mobility services. One fruit of their efforts is the Reach Now app, which supports users by combining multiple mobility services. Although such an app can contribute significantly to achieving smart mobility and thereby making the use of the private car less predominant, only a relatively small number of people use it. In this article, we adopt the S-D logic perspective to analyze the link between value formation (i.e., value co-creation and co-destruction) in customer-to-business relationships and business-to-business relationships in the service ecosystem of the Reach Now app based on an analysis of customer reviews of the Reach Now app in the Android Google Play Store between 2016 and 2019. We complement this analysis with interviews with representatives from six German public transport organizations and the Moovel Group GmbH, the app provider. Based on our analysis, we develop an interactional phase-based perspective on value formations in the tripartite relationship between app users, the Moovel Group GmbH, and public transport organizations. Our work complements previous S-D logic studies that (1) do not focus on information technology-enabled value formation, (2) neglect the concept of value co-destruction, (3) analyze only single dyadic actor-to-actor relationships, and/or (4) examine an established service ecosystem.

Keywords: Mobility as a Service (MaaS), Reach Now App, Service-Dominant Logic, Smart Mobility, Value Co-Creation, Value Co-Destruction.

Part C

13 Summary of Results

With the nine publications embedded in this thesis, we answered the three research questions that have guided our research endeavor. In the following, we summarize the most important results for each research question:

RQ1: *How do the resources of a smart mobility app provider constrain its value co-creation with (potential) customers?*

An overview of operand and operant resources (P1). Ongoing digitalization is changing the mobility sector and new roles are emerging, such as the smart mobility app provider. We conducted an interdisciplinary literature review to gain insights into the different resources forming the basis for value co-creation among smart mobility app providers. Our results show that previous work has focused on the following operand resources: a blueprint, a representation of the business model, an information system application, a national framework architecture, an information system architecture, an interface, a model and algorithm, a compensation engine, and a recommendation system. The literature review also revealed limitations with regard to some of these resources. For instance, an algorithm is able to solve an optimization problem in the case of route finding, but it cannot be used in practice due to a long running time.

In addition, our results showed that there is only a limited knowledge about the operant resources required in value co-creation among smart mobility app providers. So far, only the transition strategy, the implementation process, and the capability to ensure security and privacy have been discussed in the scientific literature. The overview on required operand and operant resources provides a good foundation for future research. In particular, we point to the need to create knowledge about what capabilities a smart mobility app provider need in order to manage value co-creation, including how it can attract actors such as potential customers and mobility providers to its service ecosystem. The results for RQ1 are summarized in Table 15.

Evaluation of apps for smart mobility (P2). One of the most important operand resources is the smart mobility app that a provider offers to its potential customers. However, scientific literature currently only provides comparisons of apps and websites available in the German-speaking European market. Hence, it is not clear to what extent these apps meet the actual desires, priorities, and needs of potential customers. Based on two preliminary studies and a conjoint analysis, we determined the preference structures for different groups of potential customers.

Our results illustrated that there are significant differences in preference structures when potential customers are grouped according to their current mobility behavior. For example, app price only does not play a predominant role in the choice decision among car drivers. We also analyzed the impact of age and of place of residence among (potential) customers on preference structures. Our results show among survey participants who use at least two different mobility services per month, app price affects the choice decisions of participants under 25 years old more than those over 25 years old. In addition, the former group’s part-worths for the attribute levels ‘real-time information’ and ‘one-click booking’ are significantly lower than the latter group’s. Furthermore, the participants who use at least two mobility services per month and live in a town (rather than in a big city or rural area) are the only group for whom the part-worth for the attribute level 'all' (including public transport, bike-sharing, car-sharing, ride-sharing, and taxi) of the attribute 'type of company' is significant.

Publication	Results
P1	▪ Overview of operand resources: blueprint, representation of the business model, information system application, national framework architecture, information system architecture, interface, model and algorithm, compensation engine, and recommendation system ▪ Overview of operant resources: transition strategy, implementation process, and capability to ensure security and privacy ▪ Central issues for future research. In particular, focus on the capability to manage value co-creation
P2	▪ Identification of relevant attributes and attribute levels for smart mobility apps ▪ Identification of the six most important attributes: Type of company, share of companies, time-table information, booking, price model, and app price ▪ Preference structures depending on the current mobility behavior of participants ▪ The effect of age and place of residence on the preference structures

Table 15. Key Results for RQ1.

RQ2: *How does the service ecosystem of a mobility provider constrain its value co-creation with a smart mobility app provider?*

Intra-role conflicts as constraint for value co-creation (P3). Digitalization is changing the mobility sector and its underlying institutional arrangements. New roles are emerging, such as the smart mobility app provider, and established roles, for instance, that of the mobility provider, are changing. Based on the literature on intermediaries in the field of electronic commerce, we derive a role framework for smart mobility app providers that consists of five roles: the informational, transactional, assurance, logistical, and customization role. Drawing on this theoretical foundation, we conducted interviews with experts from selected German transport and tariff associations to identify their potentially conflicting requirements and expectations on these roles (i.e., to observe intra-role conflicts).

Our results showed that there are especially intra-role conflicts with regard to the logistical and customization role. The transport and tariff associations surveyed often do not have the IT in place to provide smart mobility app providers with electronic/mobile tickets necessary to enable customers to access their mobility services. Furthermore, some transport and tariff associations claim the customization role themselves, which is characterized by tailoring the configurations of mobility services to meet customers' needs, in order to maintain their contacts with customers. The key results for RQ2 are depicted in Table 16.

Lack of legitimacy needs as a constraint on value co-creation (P4). Mobility providers are embedded in the institutional arrangements of their service ecosystem that enable or constrain their value co-creation. Based on scientific literature, we identified five possible legitimacy needs that can push mobility providers to engage in value co-creation with a smart mobility app provider: the need to gain market, relational, social, investment, and smart service integrator legitimacy.

Interviews with experts from different mobility providers, such as bike-sharing, car-sharing, and public transport companies, show that few of these legitimacy needs are perceived. Car-sharing companies most often perceive the need to gain market legitimacy, which is characterized by the need to establish or maintain the rights or qualifications that are necessary to continue doing business in a market or to enter into a new one. In contrast, public transport companies perceive the need to gain social legitimacy by offering a mobility service as an alternative to private car use that is attractive in the eyes of other actors, such as citizens and public authorities.

Lacking ability to build up countervailing power as a constraint on value co-creation (P5). The institutional arrangements of their service ecosystem can also constrain the disposition of mobility providers to engage in value co-creation with smart mobility app providers by limiting their ability to build up countervailing power. We conducted interviews with experts from public transport and hotel organizations to compare the effect of the different institutional arrangements in the area of price and place policies.

Our results highlighted that, unlike hotel organizations, public transport organizations are often forced to set non-dynamic and uniform prices. The underlying reasons are, for example, the prevailing public service logic, according to which ticket prices must be approved in advance by public authorities, and that all population groups (e.g., elderly people who don't use a smartphone) should pay the same ticket price regardless of the distribution channel. The political desire to provide affordable mobility to all population groups, among others, also caused that public transport organizations have no free choice of their distribution channels and conduct a long-term price and quantity optimization. On the other hand, we revealed that hotel organizations are better able to build up countervailing power based on their price and place policies, so that the underlying institutional arrangements can serve as a blueprint for the mobility sector.

Current IT choice as a constraint on value co-creation (P6). Previous studies identify several constraints that hinder value co-creation by mobility providers, predominantly from the business perspective. Now, the focus lies on the IT choice of transport and tariff associations and its influence factors. Based on expert interviews, we initially analyzed the IT choices of German transport and tariff associations with regard to four types of IT: availability of an app, of equipment for the provision of real-time timetable data, of a mobile ticketing system, and of an app for smart mobility. We illustrated that their IT choice varied greatly.

Subsequently, we conducted a QCA to get insights into the link between the configuration of a service ecosystem with regard to its actors and institutional arrangements and the choice of state-of-the-art IT. Our analysis showed that the presence of a high number of car-sharing actors in the geographical area of a transport and tariff association is a necessary condition for the choice of state-of-the-art IT. In addition, we identified two sufficient conditions for the choice of state-of-the-art IT: (1) a strong involvement of a regional authority, an advanced development stage, the availability of a high number of car-sharing actors, and the involvement of an alternative mobility provider, as well as (2) no involvement of a regional authority, no advanced development stage, the availability of a high number of car-sharing actors, and the involvement of an alternative mobility provider.

Publication	Results
P3	▪ Role framework for smart mobility app providers: Informational, transactional, assurance, logistical, and customization role ▪ Identification of intra-role conflicts that constrain value co-creation among transport and tariff associations (in particular, concerning the logistical and customization role)
P4	▪ Derivation of possible legitimacy needs of mobility providers: the need to gain market, relational, social, investment, and smart service integrator legitimacy ▪ Identification of lacking legitimacy needs among mobility providers that constrain their value co-creation
P5	▪ Derivation of sources of countervailing power that facilitate value co-creation by service providers o Price policies: Dynamic, non-personalized, non-uniform, and bundled prices o Place policies: Free choice of distribution channels, short-term price and quantity optimization, and local market ▪ Identification of lacking sources of countervailing power in the case of public transport organizations ▪ Recommendations for adjustments of institutional arrangements on the basis of the comparison with hotel organizations
P6	▪ The IT choice of transport and tariff associations is very heterogeneous ▪ Determination of configurations of a service ecosystem that are linked to the choice of state-of-the-art IT o Necessary condition: Presence of a high number of car-sharing actors in the geographical area o Sufficient conditions: (1) A strong involvement of a regional authority, an advanced development stage, the availability of a high number of car-sharing actors, and the involvement of an alternative mobility provider, and (2) no involvement of a regional authority, no advanced development stage, the availability of a high number of car-sharing actors, and the involvement of an alternative mobility provider

Table 16. Key Results for RQ2.

RQ3: *How can value co-creation among the actors in a service ecosystem for smart mobility be facilitated?*

Contradictions as drivers for change (P7). Grounded on the results of the previous studies, the question arises how value co-creation between the different (potential) actors of a service ecosystem for smart mobility can be put into practice. On the basis of expert interviews with transport and tariff associations, we illustrated that the constraints that hinder their value co-creation with a smart mobility app provider reflect contradictions located at varying points in their activity system. While the contradictions in the activity system of a transport and tariff association represent constraints for its resource integration, the contradictions in the activity system of a smart mobility app provider constrain its service exchange.

For the case of one transport and tariff association, the analysis showed that its goal to create a congruence in its activity system has led to the establishment of a value co-creation relationship with a smart mobility app provider. This step is accompanied by a number of adaptations to the elements of both activity systems (which can be summarized under an addition, modification, and substitution). The starting point for the adaptations can be seen in the introduction of a white label app for smart mobility by the provider. The key results for RQ3 are presented in Table 17.

Management of institutional logic multiplicity (P8). The institutional arrangements in which actors are embedded enable or constrain their value co-creation in a service ecosystem for smart mobility. Based on interviews with experts across multiple actors, such as a state ministry, region and city administrations, public transport companies, and smart mobility app providers, we provided empirical evidence that the service logic, in contradiction to the assumption of the S-D logic literature, is not dominant for all actors. Besides the service logic, we observed a civil society, economic, green, market, social, and state logic, which each can also be dominant.

By drawing on AT, we illustrated how an institutional logic multiplicity can induce contradictions into an activity system, representing the unit of analysis for a service ecosystem for smart mobility, that result in a limited functional range of its app(s). Our results show, for instance, that the state logic of some actors, which is reflected, among others, by the goal of maintaining data sovereignty, is partly in conflict with the service logic, preventing the sale of tickets via an app for smart mobility. By comparing four service ecosystems for smart mobility with regard to their institutional logic multiplicity and the impact on the functional range of its app(s), an awareness for possible contradictions is created, which can lead to address them, and thus to increase value co-creation among actors.

Management of value formation dependencies between dyadic actor-to-actor relationships (P9). One of the most important dyadic actor-to-actor relationships in a service ecosystem for smart mobility is between the customers and the app provider. Our analysis of customer reviews for the Reach Now app revealed that in the different interactional phases of the customer-to-business relationships there are a number of cases of value co-creation, but also of value co-destruction. For example, many customers have complained about errors during booking and payment. In addition, by conducting expert interviews, we examined the value formation (i.e., value co-creation and value co-destruction) in the dyadic business-to-business relationships between the provider of the Reach Now app and several transport and tariff associations.

Based on the results, our further analysis showed that all four possible links of value co-creation and value co-destruction in both dyadic actor-to-actor relationships occur in practice. For instance, denied access for the provider of the Reach Now app to certain ticket types leads to value co-creation on the part of the transport and tariff associations, as they ensure that their own distribution remains attractive and they can prevent overcharging. In contrast, for customers there is a value co-destruction (e.g., loss of time), as some tickets cannot be purchased via the Reach Now app.

Pub-lica-tion	Results
P7	▪ Interacting activity systems as suitable analysis unit for lacking value co-creation between actors in the context of smart mobility ▪ The AT-related concept of contradictions helps to identify constraints to resource integration and service exchange of actors (i.e., on their value co-creation) ▪ The pursuit of congruence leads to adaptations in the elements of the activity systems (reflected by an addition, modification, and substitution). The adaptations can involve an establishment of a value co-creation relationship with an actor, such as a smart mobility app provider
P8	▪ An activity system as suitable analysis unit for value co-creation in a service ecosystem for smart mobility ▪ Identification of different institutional logics that possibly influence the value co-creation of its actors: Civil society, economic, green, market, service, social, and state logic ▪ Empirical evidence that institutional logic multiplicity can induce contradictions that constrain the functional range of app(s) for smart mobility
P9	▪ Overview on the value formation in the dyadic relationships between the customers and the provider of the Reach Now app o Value co-creation is based, in particular, on the provision of a special ticket type, and of an app with a high stability and a good functional design o Value co-destruction is caused, among others, by booking and payment errors, inability to buy tickets for public transport, and crashes of the app ▪ Overview on the value formation in the dyadic relationships between the transport and tariff associations and the provider of the Reach Now app ▪ Empirical evidence that all four possible value formation links (i.e., combinations of value co-creation and value co-destruction) between the two dyadic relationships occur in practice

Table 17. Key Results for RQ3.

14 Discussion

Based on the summary of our results, we subsequently discuss the main theoretical and practical implications of our work. This section ends with an acknowledgement of the limitations of our work and suggestions for future research.

14.1 Implications for Theory

With our work, we make several theoretical contributions to the **establishment** and further development of the S-D logic perspective. Vargo and Lusch (2004) introduced the S-D logic perspective into marketing and many other scholars have subsequently applied it in numerous other fields of research, such as service science (Gebauer et al., 2010; Vargo and Akaka, 2009, etc.), travel/transportation (Dolan et al., 2019; Sthapit and Björk, 2019; Yin et al., 2019, etc.), and public business administration (e.g., Osborne, 2018; Osborne et al., 2013). An overview of its application, among others, in the IS field, is provided by Brust et al. (2017). Their results showed that, at the time, previous IS studies had not focused on the mobility context. Later, some mobility-focused IS research was published (e.g., Gilsing et al., 2018; Hein et al., 2018; Turetken et al., 2019), but none has focused on IT-supported use of multiple mobility services for a trip from an origin to a destination. Our work thus contributes to establishing the S-D logic perspective as a theoretical lens in the IS field for studying the (intended) shift from private car use to the use of multiple mobility services.

Besides establishing the S-D logic perspective, we make several contributions to its **further development** towards a midrange theory. Many previous studies taking the S-D logic perspective are conceptual in nature, since the S-D logic perspective is on a meta-theoretical level that makes a direct testing, verification, and application difficult (Vargo and Lusch, 2017). To address these limitations, a recent call for future research by Vargo and Lusch (2017, p. 46) highlighted the need to develop "more midrange theoretical frameworks and concepts of service exchange, resource integration, value cocreation, value determination, and institutions/ecosystems. These midrange theories can be partially informed by theories outside of marketing […]. Evidence-based research is also needed; opportunities exist in areas such as […] the study of the service of cognitive mediators (assistants) as heuristic tools in complex service ecosystems". Our theoretical contributions to the further development of the S-D logic perspective can be assigned to its three main concepts: (1) the service ecosystem, (2) the service platform, and (3) value co-creation (Hein et al., 2018; Lusch and Nambisan, 2015).

First, we contribute to the S-D logic literature on **service ecosystems** by providing answers to the open questions "How do keystone actors in an ecosystem establish their position?" and "How do service ecosystems adapt and evolve?" (Vargo and Lusch, 2017, p. 50). The ongoing digitalization is changing nearly all service sectors, such as education, finance, health, and mobility. New roles are emerging, established roles are changing, and often there is a blurring of the boundaries of roles. A single public transport company, for example, is often not able to satisfy complex customer needs (seamless transport from an origin to a destination), which in the past has forced (potential) customers to identify, compare, and combine mobility services offered by different providers (Alt et al., 2019).

New emerging smart mobility app providers take an intermediary position between their customers and mobility providers, and support the satisfaction of complex customer needs by providing individualized, context-aware, and dynamic combinations of mobility services. In addition, the boundaries between customers and mobility providers are blurring as customers also conduct resource integration and service exchange (in other words, engage in value co-creation) (Vargo and Lusch, 2017). For instance, a customer can provide information on how crowded a bus is (Nunes et al., 2014) that can be used by the smart mobility app provider to improve the quality of its recommendations to other customers.

Based on the literature on intermediaries in the field of electronic commerce (Anderson and Anderson, 2002; Bakos, 1998; Brousseau, 2002; Giaglis et al., 2002; Sarkar et al., 1995), we initially derived a role framework for smart mobility app providers, which includes the informational, transactional, assurance, logistical, and customization role, in order to create a theory-based understanding of this new actor role (P3). This role framework contributes to a better knowledge of how these actors establish their position by providing insights into their specific tasks. For instance, the offer of a one-stop purchase to customers, and the related need to settle payments with the mobility providers lead to a prominent position.

In addition, the role framework can be used to analyze the problems smart mobility app providers face in establishing their position in practice, or one step before, in building up their service ecosystem, as evidenced by Albrecht and Ehmke (2016) and Willing et al. (2017a; 2017b). By applying role conflict theory (e.g., Biddle, 1979; Koch and Schultze, 2011), we show that conflicting role expectations (attitudes, beliefs, and norms) of the transport and tariff associations lead them to not enter these service ecosystems. For example, the transport and tariff associations often claimed the customization role itself, with the aim of maintaining customer contact.

Similarly, the results of two further studies showed how the institutional arrangements of the service ecosystem in which a mobility provider is embedded can negatively influence the emergence of the service ecosystem of a smart mobility app provider. In the first study (P4), we complement the S-D logic perspective with the institutional theory that is established in numerous scientific fields, such as sociology (e.g., DiMaggio and Powell, 1983; Meyer and Rowan, 1977), management (e.g., Dacin et al., 2007; Provan et al., 2015), and IS (for an overview, see Mignerat and Rivard, 2009). In particular, we draw on the concept of legitimacy, which, according to Suchman (1995, p. 574), is defined as "a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions".

Relying on this understanding of legitimacy, and based on the work of Dacin et al. (2007), we derived five types of possible legitimacy needs: market, relational, social, investment, and smart service integrator legitimacy. Our interviews with mobility providers provide empirical evidence that they are confronted with varying, but overall very few of these legitimacy needs, which leads them not to join the service ecosystem of a smart mobility app provider.

In the second study (P5), we chose a similar approach to show how the institutional arrangements of the service ecosystem of a mobility provider influence the emergence of the service ecosystem of a smart mobility app provider. We complement the S-D logic perspective with the concept of (countervailing) power to provide a suitable theoretical basis for our empirical study. The concept of power is the subject of several scientific fields, such as administrative science (e.g., Pfeffer and Moore, 1980), political science (e.g., March, 1966), and sociology (e.g., Emerson, 1962). In contrast, it is often neglected in the IS field (Simeonova et al., 2018). According to Maloni and Benton (2000, p. 53) power is “the ability of one firm (the source) to influence the intentions and actions of another firm (the target)”, while countervailing power is defined as the ability of one actor to limit the exercise of power (Galbraith, 1993).

Our expert interviews with public transport organizations showed that the institutional arrangements affect their price and place policies in such a way that they can build up only little countervailing power. For example, the public service logic, according to which everyone (e.g., including elderly people who do not use smartphones) should pay the same ticket price regardless of the distribution channel, prevents non-uniform pricing. This in turn leads to a low countervailing power against the smart mobility app providers, which contributes to their difficulties in establishing a broad service ecosystem. By comparing the situation with that of hotel organizations, we provide theory- and evidence-based guidelines for the adaptation of the institutional arrangements.

In addition, we contribute to a better understanding on the possible further evolution of the service ecosystem of smart mobility app providers by analyzing the IT choice in the service ecosystem of different mobility providers (P6). In the past, the focus of the transport and tariff associations (each represents a service ecosystem) was on the provision of a transport service between stations. However, due to digitalization and related developments, such as the emergence of apps for smart mobility, an increasing competitive pressure caused by new actors like car-sharing companies (Willing et al., 2016), and changing customer requirements, there is an increasing need to adopt state-of-the-art IT. For example, the transport and tariff associations need to implement sensors to provide real-time timetable data to their customers and to smart mobility app providers.

For the study of the IT choice, we introduced the concept of technology choice into the S-D logic literature, which is established, among others, in economics (e.g., Gray and Shadbegian, 1998), production management (e.g., Drake et al., 2016), and IS (Klischewski and Ukena, 2009; Liu et al., 2013, etc.). As analysis method, we applied the QCA that is currently still little used in the IS field (Soto Setzke et al., 2020). This is a set-theoretic method, which, in contrast to traditional regressions-based models, makes it possible to identify configurations of the service ecosystem with regard to its actors and its institutional arrangements that are linked to the choice of state-of-the-art IT. Through its application, we contribute to the further establishment of the QCA in the IS field, illustrating its suitability for the analysis of service ecosystem-related issues.

In summary, we contribute to a better understanding of how a keystone actor (a smart mobility app provider) establishes its position in a service ecosystem, and of how the institutional arrangements of others service ecosystems (e.g., mobility providers) constrain the emergence and/or scope of its service ecosystem. In line with the recent call for future research by Vargo and Lusch (2017), we used several theories and concepts (intra-role conflict, legitimacy, countervailing power, and technology choice) that are well established in numerous scientific fields beyond marketing to complement the S-D logic perspective in order to provide insights into the effects of institutional arrangements, where knowledge is currently in its infancy.

Second, we contribute to the S-D logic literature on **service platforms** in a smart mobility context. The emergence of the role of the smart mobility app provider is fueled by digitalization, and thus the research on these apps is still very limited. Until today, the scientific literature only offers comparisons of apps and websites available for German-speaking European countries (Albrecht and Ehmke, 2016; Willing et al., 2017a; 2017b). These showed, for example, that most of the smart mobility apps do not allow customers to book and pay for the mobility services, and that they only draw on static customer data for their recommendations.

However, the reasons for this are unclear. To cast light on this question, we first conducted an interdisciplinary literature review to provide insights on the operand and operant resources of smart mobility app providers (P1). Our analysis revealed some shortcomings in the operand resources (e.g., algorithms, information system architecture) underlying an app for smart mobility, and thus limiting its functionality. In addition, we highlight central issues for future research, especially the need to study the operant resources, such as the capability to manage value co-creation.

Furthermore, we complement previous studies (Albrecht and Ehmke, 2016; Willing et al., 2017a; 2017b) that provide a comparison of apps for smart mobility by determining the preference structures of potential customers (P2). According to Willing et al. (2017b, p. 178) “evaluating the quality and the success factors of the different intermodal solutions, can provide insight into the above question [what constitutes a good intermodal value proposition] from a business model perspective and will open up further opportunities for IS researchers to work towards the seamless integration of modes”. With our work, we provide a basis for the evaluation of the quality of different apps for smart mobility and for the determination of the success factors from the perspective of potential customers.

Initially, we identify relevant attributes and their attribute levels of apps for smart mobility based on a review of scientific literature and by analyzing customer reviews of four smart mobility apps. Subsequently, we identified the six most important attributes by carrying out a preliminary study with potential customers and an expert from the mobility field. Lastly, we performed conjoint analysis (Backhaus et al., 2015) to determine the preference structures of different groups of potential customers, and thus provide empirical evidence of the extent to which a specific app for smart mobility meets their actual desires, priorities, and needs. We identified significant differences in the preference structures if potential customers are grouped depending on their current mobility behavior, age, and place of residence. Accordingly, future research should take these segmentation criteria into account in order to generate deeper knowledge.

Third, we contribute to closing the research gap in the S-D logic literature that exists in terms of **value co-creation** – “we know very little about how economic actors engage in the process of value co-creation in traditional, co-located contexts […], let alone in technology-enabled ones” (Breidbach and Maglio, 2016, p. 74) – in particular, by introducing AT (e.g., Engeström, 1987; Kuutti, 1996) as a complementary theoretical perspective. AT has its origin in psychology (Leont’ev, 1978; Vygotsky, 1978), but has since been applied in various research fields, such as management science (e.g., Jarzabkowski, 2003), education (e.g., Dionne and Bourdon, 2018) and IS (Hasan et al., 2017; Malaurent and Karanasios, 2020, etc.).

According to Vargo and Lusch (2017), value co-creation of an actor includes resource integration and service exchange, which we defined as two successive actions of its value co-creation activity. Our approach is in line with the suggestion to use actor engagement as microfoundation for value co-creation (Storbacka et al., 2016). The basic unit of analysis of AT is the activity system, which includes, among others, the instruments element, which makes it suitable for the IT (e.g., an app) used during an activity (Engeström, 1987; Kuutti, 1996). Hence, we provide a better theoretical foundation for the analysis of IT-enabled value co-creation. In particular, we illustrate that the activity system is a suitable unit of analysis for value co-creation between the actors of one service ecosystem (P8), as well as, in the case of two or more interacting activity systems, for the lack of value co-creation between actors embedded in different service ecosystems (P7).

In addition, our work illustrates the relevance of the two AT-based concepts of contradictions (Engeström, 1987) and congruence (Allen et al., 2013) in developing theory-driven strategies for establishing value co-creation relationships between actors, and for increasing value co-creation in established relationships. Our results provide empirical evidence that mobility providers and smart mobility app providers strive to create a congruence in their activity system by solving the contradictions through different adaptations in the elements of their activity system (reflected by an addition, modification, and substitution). These adaptations can involve the establishment of a value co-creation relationship between a mobility provider and a smart mobility app provider (P7).

Furthermore, we find that there is an institutional logic multiplicity among the different actors of a service ecosystem of a smart mobility app provider, which can induce contradictions into the activity system that are reflected in the limited functional range of a smart mobility app, and thus constrain the IT-enabled value co-creation (P8). With the introduction of the concept of institutional logic multiplicity, we question the previous approach of scholars to (at least implicitly) assume that service logic is the dominant logic for all actors of a service ecosystem (Vargo and Lusch, 2017). Instead, we emphasize the need to determine the institutional logics of all actors and to identify possible different dominant institutional logics in order to gain a more profound understanding of the (lack of) value co-creation in a service ecosystem. Based on institutional literature from varying scientific fields (e.g., Grinevich et al., 2019; Vickers et al., 2017), we identified institutional logics (e.g., economic, green, and state logic), which further research in a (smart) mobility context should take into account.

In addition, our work helps to reduce the value "co-creation myopia" (Plé, 2016, p. 154) that is currently prevalent in the S-D logic literature by focusing the attention of scholars to the concept of value co-destruction (P9). Most (IS) studies have only analyzed the positive results of resource integration and service exchange (i.e., value co-creation) among actors (e.g., Gilsing et al., 2018; Hein et al., 2018), while possible negative results (i.e., value co-destruction) have not been considered (e.g., Laud et al., 2019; Leroi-Werelds, 2019; Plé and Cáceres, 2010). This leads to the unjustifiably positive assessment of the function and long-term viability of service ecosystems.

By providing an overview on studies examining value co-creation (e.g., Dolan et al., 2019; Gilsing et al., 2018; Hein et al., 2018) and/or value co-destruction (e.g., Sthapit and Björk, 2019; Yin et al., 2019) in dyadic customer-to-business relationships and business-to-business relationships in a mobility context, we provide a consolidated knowledge for future research on value formation in dyadic actor-to-actor relationships. Building on this, we improved our understanding of the link between the value formations in both dyadic actor-to-actor relationships, which has been largely neglected in previous research (Sigala, 2018; van Riel et al., 2019). By drawing on our case study, we showed that all possible links of value co-creation and value co-destruction occur in practice.

In summary, we followed the call of Vargo and Lusch (2017) and further developed the S-D logic perspective towards a midrange theory by informing it with theories and concept outside of marketing. Our contributions are centered on the three main concepts of the S-D logic perspective: (1) the service ecosystem, (2) the service platform, and (3) value co-creation (Hein et al., 2018; Lusch and Nambisan, 2015). The extended S-D logic perspective offers scholars a broad theoretical basis for conducting evidence-based research, which can complement the conceptual studies that dominate the S-D logic literature to date (Vargo and Lusch, 2017). Furthermore, by analyzing smart mobility issues, we contribute to the S-D logic literature which a focus on a mobility context, as well as on digital assistants, where research is currently still very limited (Brust et al., 2017; Vargo and Lusch, 2017).

14.2 Implications for Practice

In developing the S-D logic perspective towards a midrange theory, we are able to conduct evidence-based research with various practical implications. Our work contributes to the emergence of service ecosystems for smart mobility, to their functioning, and thus to improving their long-term viability. In other words, we support the ongoing efforts of actors to shift from the G-D logic to the S-D logic. In order to make this contribution, we first identified the **conflicting desires, priorities, and needs of different actors that constrain the establishment of service ecosystems for smart mobility**, and thus the IT-enabled value co-creation, in practice.

Initially, we provide insights into the preference structures of different groups of **potential customers** that can be used to design apps for smart mobility that better meet their actual needs, which contributes to their adoption. This is important since, until now, smart mobility has been more of a vision than a reality, as evidenced by the ongoing problems (e.g., traffic congestion, air and noise pollution) caused by the predominant use of the private car (Schreieck et al., 2018; Willing et al., 2017a; 2017b). Extant scientific literature has not sufficiently informed practitioners about the preferences of potential customers, because of methodological limitations (Grotenhuis et al., 2007; Stopka, 2014), or because of their limited focus on comparing apps and websites for smart mobility in German-speaking European countries without considering the preference structures of (potential) customers (Albrecht and Ehmke, 2016; Willing et al., 2017a; 2017b).

Our conjoint analysis showed that the preference structures of different groups of potential customers vary depending on their current mobility behavior, their age, and their place of residence (P2). For example, the participants who use at least two different mobility services per month and live in a town are the only one for whom the part-worth for the attribute level ‘all’ (including public transport, bike-sharing, car-sharing, ride-sharing, and taxi) of the attribute ‘type of company’ is significant. Based on the estimated part-worth for the attribute levels of the attributes, practitioners can design an app for smart mobility that is particularly attractive for a specific target group. A detailed knowledge about the differences in preference structures of potential customers is important for the initiation of a value co-creation relationship, since, according to the S-D logic perspective (Vargo et al., 2008), a smart mobility app provider can only make a value proposition that is accepted or rejected by potential customers.

In addition, we define the new emerging role of **smart mobility app providers**, including their desires, priorities, and needs (P1 and P3). Currently, we have a limited understanding of their role (e.g., Caiati et al., 2020; Lyons et al., 2020) so successful coordination of the efforts of practitioners is difficult. On a higher level, the nature of the new role is characterized by (1) the goal to better satisfy complex customer needs, and (2) the ongoing technological progress and digitalization, which enable a new form of cooperation among actors. By using examples from various service sectors, such as education, finance, health, and mobility, Alt et al. (2019) illustrated that, until recently, customers themselves have to combine services of several providers to satisfy their complex needs. For instance, the public transport services provided by a high number of bus, subway, and tram companies have to be manually compared, selected, and coordinated for a trip from an origin to a destination. This is, however, accompanied by a high cognitive effort (Lyons et al., 2020), which contributes to the predominant use of the private car. On the other hand, “technologies that rely on sensors, big data, open data, new ways of connectivity and exchange of information (e.g., Internet of Things, RFID, and NFC)” (Gretzel et al., 2015, p. 179), provide new possibilities to compare, select, and coordinate the services of different providers, and to offer potential customers an integrated solution.

At the subordinate level, our role framework for smart mobility app providers helps practitioners to identify the conflicting desires, priorities, and needs of other actors (i.e., intra-role conflicts) that constrain value co-creation. For example, the wish of transport and tariff associations not to lose direct customer contact contrasts with the customization role of smart mobility app providers.

Lastly, we contribute to the knowledge about why most **mobility providers** have not entered into the service ecosystem of smart mobility app providers (i.e., why they do not engage in value co-creation) in practice, by examining the institutional arrangements of the service ecosystem in which they are embedded. According to Albrecht and Ehmke (2016), for example, only five out of nine of the analyzed apps and websites include access to at least one public transport company. This is a major shortcoming since public transport is seen as the backbone of smart mobility (Smith et al., 2020; Wright et al., 2020). Based on this, our work is primarily focused on the conflicting desires, priorities, and needs of transport and tariff associations as well as of their public transport companies, respectively, which are shaped by the institutional arrangements of their service ecosystem.

Our results showed, for example, that transport and tariff associations do not have the need to increase market legitimacy, which is characterized by the need to establish or maintain the rights or qualifications that are necessary to continue doing business in a market or to enter into a new one (P4). One reason for this is that the transport and tariff associations and their underlying institutional arrangements form a kind of regional monopoly which prevent competition between public transport companies, for instance, through the tendering of routes and the application of uniform tariffs.

In addition, we revealed that the institutional arrangements limit the ability of public transport organizations to build up countervailing power against smart mobility app providers by restricting their price and place policies (P5). Examples for corresponding institutional arrangements are the need to approve ticket prices in advance by public authorities, and their desire that all population groups (e.g., elderly people who do not use smartphones) should pay the same ticket price regardless of the distribution channel. By comparing their situation with that of private mobility providers (e.g., car-sharing companies) (P4) and hotel organizations (P5), we provide practitioners with insights how they can adapt the institutional arrangements in order to increase the need for legitimacy and the ability to build up countervailing power. This, in turn, can increase their disposition to engage in value co-creation with smart mobility app providers.

However, the disposition of a mobility provider to engage in value co-creation with smart mobility app providers depends not only on economic considerations, but also on the available IT (e.g., implementation of equipment for the provision of real-time timetable data and a mobile ticketing system). Our QCA showed that the IT choice of a transport and tariff association (i.e., of a service ecosystem) is linked to the actors and to the institutional arrangements present (P6). In particular, the presence of a high number of car-sharing actors in the geographical area of a transport and tariff association is a necessary condition for the choice of state-of-the-art IT. Accordingly, we make a call to practitioners to improve the market environment for car-sharing companies, for instance, through the provision of more car-sharing parking spaces. In addition, in order to prevent the negative effects, such as air and noise pollution, which are caused by vehicles with combustion engine, electric car-sharing should be promoted (e.g., by setting up a charging infrastructure).

Second, we support **the establishment of value co-creation relationships** between smart mobility app providers and mobility providers, **and thus of service ecosystems for smart mobility**, in practice by complementing the S-D logic perspective with AT (P7). Our theoretical basis can serve as a blueprint for practitioners to systematically analyze the lack of resource integration and service exchange (i.e., value co-creation) among actors embedded in the same or in different service ecosystems. The activity system, which serves as the prime unit of analysis (Engeström, 2001), creates an awareness among practitioners of the elements (e.g., rules, division of labor) and the relationships among them that influence value co-creation. Since the activity system includes the instruments element, it is possible to take into account the contradictions that are induced by technological progress and digitalization.

Our results showed that one transport and tariff association entered a value co-creation relationship with a smart mobility app provider in order to reduce contradictions in its activity system and to increase congruence between its elements. More precisely, the smart mobility app provider offered a white label solution so that the transport and tariff association can itself provide smart mobility in its geographical area. Based on the analysis of the activity system of other transport and tariff associations, further possible starting points for establishing a value co-creation relationship can be derived.

For example, previous studies have shown that public organizations, such as transport and tariff associations, have weaker big data analytics capabilities than private companies (e.g., Klievink et al., 2017; Okwechime et al., 2018). On the other hand, “generated data on [smart mobility apps] creates the unique opportunity for service providers [i.e., mobility providers] to analyze how their individual business model performs in the context of competing and complementary services” (Willing et al., 2017a, p. 277). Based on this, smart mobility app providers can provide information based on a big data approach which can be used by transport and tariff associations, for instance, to optimize their timetables.

Third, we contribute to **the improved functioning of established service ecosystems for smart mobility**, and thus to their long-term viability, by providing **insights into how to increase value co-creation** among their actors. Our study shows that actors have different institutional logics (e.g., economic, green, and service logic) and sometimes also varying dominant institutional logics. This so-called logic multiplicity can limit the functional range of apps for smart mobility (P8). We identified, for example, the state logic of a transport and tariff association, which, among others, is characterized by the aim to provide public transport even in unprofitable areas and at unprofitable times. For this reason, its focus is on the provision of an own app/website for smart mobility and on maintaining direct customer contact and data sovereignty.

As a result, a private smart mobility app provider cannot offer one-click booking and payment because separate customer accounts are needed. Due to the distribution of customer data among several actors, the possibility of gaining insights for the future design of public transport services through big data analytics is also limited. Hence, the question arises whether it is necessary that transport and tariff associations continue to follow the state logic in practice. This seems questionable, since technological progress enables, for example, new on-demand mobility services (e.g., Rayle et al., 2014; Steiner and Irnich, 2020), which can be operated successfully in previously not profitable areas.

Furthermore, we make practitioners aware of the need to manage value formation (i.e., value co-creation and value co-destruction) beyond single dyadic actor-to-actor relationships in order to ensure the long-term viability of service ecosystems for smart mobility (P9). Initially, the analysis of customer reviews provided for the Reach Now app reveals that the value co-creation is based, in particular, on the provision of a special ticket type, and of an app with a high stability and a good functional design. In contrast, the value co-destruction is caused primarily by booking and payment errors, the inability to buy tickets for public transport, and crashes of the app. In other words, the value formation of customers is currently centered on the fulfilment of basic requirements put on an app, as well as on the resource integration and service exchange during the booking and payment phase. The second point is critical because many of the available apps for smart mobility do not support customers at all during this phase (Albrecht and Ehmke, 2016).

A value co-creation typical for smart mobility, such as trip recommendations that take into account how crowded a bus is (Nunes et al., 2014), or how clean its seats are, plays a minor role and has great potential for the future. Our further analysis showed how the value formations in the customer-to-business relationships and business-to-business relationships are linked. For instance, the lack of sales of certain tickets via the Reach Now app leads to value co-destruction for customers (e.g., loss of time), while transport and tariff associations experience a value co-creation because they prevent possible overcharging.

In summary, our work provides practitioners with detailed insights into the emergence, functioning, and long-term viability of service ecosystems for smart mobility. We achieved this by shedding light on conflicting desires, priorities, and needs of potential actors, on how a value co-creation relationship between mobility providers and smart mobility app providers can be established, and on how to increase value co-creation among actors that are embedded in these service ecosystems.

14.3 Limitations and Future Research

Despite our efforts, our work has some limitations that should be addressed in future research. As a superordinate theoretical lens, we have adopted the S-D logic perspective (Vargo and Lusch, 2004; 2017), which is well-established in numerous scientific fields, such as service science (Gebauer et al., 2010; Vargo and Akaka, 2009, etc.), travel/transportation (Dolan et al., 2019; Sthapit and Björk, 2019; Yin et al., 2019, etc.) and public business administration (e.g., Osborne, 2018; Osborne et al., 2013). The literature review provided by Brust et al. (2017) showed, however, that the S-D logic perspective has not been applied in a mobility context in the IS field. This is only the case in a few later published articles (e.g., Gilsing et al., 2018; Hein et al., 2018; Turetken et al., 2019). This is somewhat surprising since the S-D logic perspective with its three main concepts (service ecosystem, service platform, and value co-creation) provides a good theoretical foundation for the analysis of the (intended) shift from private car use to the use of IT-based mobility services.

However, there are several other theories and perspectives, in particular with regard to the concept of value co-creation (for an overview, see Kohtamäki and Rajala (2016) and Reypens et al. (2016)) that might serve as alternative theoretical foundation. Future research should compare the explanatory power of the S-D logic perspective to these other approaches. Furthermore, a more pronounced understanding of value co-creation can be gained by focusing on different types of value. For this purpose, the typology provided by Leroi-Werelds (2019) can be used, according to which the customer value includes, for example, personalization, control, as well as ecological and societal benefits.

Further limitations exist due to the chosen mixed methods research design, which is defined as "the sequential or concurrent combination of quantitative and qualitative methods (e.g., data collection, analysis and presentation) within a single research inquiry" (Venkatesh et al., 2013, p. 24). Its application is justified in the present work, since we aimed to achieve several of its purposes, such as complementarity, completeness, developmental, expansion, and diversity (Venkatesh et al., 2013). Because the scientific literature is limited in terms of both the context of our work – smart mobility – (with the exception of Albrecht and Ehmke (2016) and Willing et al. (2017a; 2017b)), as well as the further development of the S-D logic perspective towards a midrange theory (Vargo and Lusch, 2017), we relied mainly on expert interviews.

While the use of qualitative methods is recommended in such an emerging research field (Yin, 2018), future research should confirm and complement our results by applying quantitative methods (e.g., extensive surveys of transport and tariff associations). In addition, further quantitative methods besides the conjoint analysis should be applied to investigate the choice and adoption of an app for smart mobility by potential customers. While the conjoint analysis takes a techno-economic perspective to determine how different attributes and their attribute levels of apps for smart mobility affect the choice decision of potential customers (Naous and Legner, 2017), psychological (e.g., loss aversion, social imitation) and motivational factors, such as hedonic motives, perceived usefulness, and perceived ease of use, should also be considered (Lyons et al., 2020; Schikofsky et al., 2020).

With the increasing spread of apps for smart mobility in the population, there are also extensive research opportunities with regard to the concept of continuous use, and how their use changes mobility behavior. With regard to the latter, it is interesting, for example, whether incentives, such as dynamic prices, which are well-known from airlines, or seat reservations can be used to improve the capacity and/or revenue management of public transport companies.

Since we only collected data in Germany, there are some limitations with regard to the generalizability of our results. Several reasons justified the focus on Germany: (1) As in most industrialized countries, there is a need to reduce the private car use to avoid its negative consequences, such as air and noise pollution, traffic jams and a lack of parking spaces. This is evidenced by the decision by some cities to ban diesel cars in certain zones to reduce air pollution (ADAC, 2019); (2) in addition to the legal conditions, in particular, the pre-existing infrastructure and a high public pressure contribute to the efforts aiming to shift mobility behavior away from private car use (Marx et al., 2015; Willing et al., 2017b). It is therefore not surprising that some of the first and best known smart mobility approaches have a focus on Germany (Albrecht and Ehmke, 2016; Willing et al., 2017a; 2017b) and Europe (Lyons et al., 2020); and (3) similar to other industrialized countries (e.g., Great Britain, France and the United States), the younger generation is more open to app-based mobility services, and the importance of private car ownership, as well as of the emotional attachment to the car, is lower than in older generations (Bratzel, 2018; Circella et al., 2017; Kuhnimhof et al., 2012; Rayle et al., 2014; Umweltbundesamt, 2019).

Recognizing these specific characteristics of Germany, we call for comparative studies to identify country-specific differences in value co-creation among the actors of service ecosystems for smart mobility. For example, a comparison between Germany and the United States would shed light on the role of city planning, existing public transport infrastructure, legislative social welfare priorities and mobility behavior of the population.

In addition, future research should focus on additional and potential future actors of the service ecosystems for smart mobility. Since public transport is seen as the backbone of smart mobility (Smith et al., 2020; Wright et al., 2020), our data collection and analysis is largely limited to the transport and tariff associations and their public transport companies, respectively. However, our analysis of their legitimacy needs showed that these differ in part from those of bike- and car-sharing companies (P4). In other words, our results for the public transport companies can only be transferred to other mobility providers to a limited extent. This limitation may be due to differences between public and private mobility services and/or how well-established various mobility providers are in the mobility market.

According to Storbacka et al. (2016, p. 3010) “the physical taxi (technology), the driver (human), the passenger (human), and other vehicles (human-technology entities) can be considered as actors”. Based on this understanding, future studies also should analyze how autonomous vehicles change service ecosystems for smart mobility, their service platforms, and value co-creation among their actors. For example, the spread of autonomous vehicles will make large amounts of data available (e.g., roads condition, weather), which enable new forms of value co-creation. On the other hand, there is a high potential for value co-destruction based on over-emphasizing the need of data sovereignty and data security violations. The study conducted by Yap et al. (2016) analyzing the preferences for using automated vehicles can serve as a starting point.

Due to technological progress and digitalization, the boundaries between the mobility and the energy sector are blurring. An electric vehicle can, for instance, be used as a decentralized power plant in a situation where the renewable power plants (e.g., solar and wind plants) generate less power than needed (Docherty et al., 2018; Laurischkat and Jandt, 2018), or alternatively, it can be used by its owner to drive. Accordingly, these service ecosystems to be examined include additional actors, such as (decentralized) power plants, electricity network operators, and electricity customers.

One of the challenges is to govern these actors via the electricity price and the feed-in tariff in such a way that supply and demand in the energy market are balanced. One technology that is becoming increasingly important in this context is blockchain technology (Kirpes and Becker, 2018). In connection with the goal of achieving a market balance in the electricity market, it is necessary to make the mobility behavior of the population more flexible. Both with regard to the switch between private car use and the use of (combinations of) mobility services, as well as between the use of different mobility services (e.g., car-sharing, public transport). IT can make an important contribution to making mobility behavior more flexible. This thesis provides insights into the emergence, functioning and long-term viability of service ecosystems for smart mobility by adopting the S-D logic perspective, which is centered around the concepts of service ecosystem, service platform, and value co-creation, and can serve as a basis for future studies.

15 Conclusion

Technological progress and the digitalization are changing the mobility sector. Smart mobility, which is defined as the individual, context-aware, and dynamic combination of multiple mobility services for a trip from an origin to a destination, can contribute to the reduction of private car use, and thus to address related problems (e.g., time and energy wasted waiting in traffic or looking for a parking space, air and noise pollution, including greenhouse gas emissions contributing to global warming). In practice, however, smart mobility is still more of a vision than a reality, and it is unclear how actor-to-actor networks can be established, how to improve their function, and how to ensure their long-term viability.

In order to shed light on these issues, we adopt the S-D logic perspective centered around its three main concepts: the service ecosystem, the service platform, and value co-creation. The biggest drawback of the S-D logic perspective is that it is situated at the meta-theoretical level, which makes its direct testing, verification, and application difficult. Following a recent call for future research, we further develop the S-D logic perspective towards a midrange theory by complementing it with additional theories (e.g., role conflict theory, AT) and concepts (legitimacy, countervailing power, technology choice, etc.).

We provide empirical evidence by collecting data from several (potential) actors of these service ecosystems for smart mobility, such as customers, mobility providers, public authorities, and smart mobility app providers in Germany. Our results show that actors have conflicting desires, priorities, and needs that prevent value co-creation and thus the establishment of service ecosystems for smart mobility. For example, mobility providers want to retain direct contact with their customers. In addition, we illustrate how a value co-creation relationship between a transport and tariff association and a smart mobility app provider can be established by introducing a white label app.

Finally, we provide insights into how value co-creation in established service ecosystems for smart mobility can be increased, and thus their long-term viability supported. Our results highlight the need to manage logic multiplicity among different actors and the link between value formations (a concept that takes into account both value co-creation and value co-destruction) in dyadic actor-to-actor relationships. In summary, our work contributes to the emergence, function, and long-term viability of service ecosystems for smart mobility in practice, as well as to the further development of the S-D logic perspective towards a midrange theory.

References

Abenoza, R. F., Cats, O., and Susilo, Y. O. (2017): "Travel Satisfaction with Public Transport: Determinants, User Classes, Regional Disparities and Their Evolution", *Transportation Research Part A: Policy and Practice,* Vol. 95, pp. 64-84.

ADAC (2019): *Dieselfahrverbot: Alle Fragen und Antworten*. URL: https://www.adac.de/rund-ums-fahrzeug/abgas-diesel-fahrverbote/fahrverbote/dieselfahrverbot-faq/ (visited on 29-01-2019).

Adler, P. A. and Adler, P. (1994): "Observational Techniques", Denzin, N. K., and Lincoln, Y. S., *Handbook of Qualitative Research,* SAGE Publications, Thousand Oaks. pp. 377-392.

Agussurja, L., Cheng, S.-F., and Lau, H. C. (2019): "A State Aggregation Approach for Stochastic Multiperiod Last-Mile Ride-Sharing Problems", *Transportation Science,* Vol. 53, No. 1, pp. 148-166.

Ahlers, D., Akerkar, R., Krogstie, J., Opdahl, A. L., Tessem, B., and Zhang, W. (2018): "Harnessing Mobility Data in Cities: A Case Study from the Bergen Region", *Norsk konferanse for organisasjoners bruk av informasjonsteknologi*. Svalbard.

Akaka, M. A., Vargo, S. L., and Lusch, R. F. (2013): "The Complexity of Context: A Service Ecosystems Approach for International Marketing", *Journal of International Marketing,* Vol. 21, No. 4, pp. 1-20.

Albrecht, L. and Ehmke, J. F. (2016): "Innovative Services in der Mobilitätsbranche: Eine Marktanalyse Multimodaler Mobilitätsmanager", *Multikonferenz Wirtschafts-informatik*. Ilmenau.

Alexander, M. J., Jaakkola, E., and Hollebeek, L. D. (2017): "Zooming Out: Actor Engagement Beyond the Dyadic", *Journal of Service Management,* Vol. 29, No. 3, pp. 333-351.

Allen, D. K., Brown, A., Karanasios, S., and Norman, A. (2013): "How Should Technology-Mediated Organizational Change Be Explained? A Comparison of the Contributions of Critical Realism and Activity Theory", *MIS Quarterly,* Vol. 37, No. 3, pp. 835-854.

Alt, R., Ehmke, J. F., Haux, R., Henke, T., Mattfeld, D. C., Oberweis, A., Paech, B., and Winter, A. (2019): "Towards Customer-Induced Service Orchestration - Requirements for the Next Step of Customer Orientation", *Electronic Markets,* Vol. 29, No. 1, pp. 79-91.

Amatuni, L., Ottelin, J., Steubing, B., and Mogollón, J. M. (2020): "Does Car Sharing Reduce Greenhouse Gas Emissions? Assessing the Modal Shift and Lifetime Shift Rebound Effects from a Life Cycle Perspective", *Journal of Cleaner Production,* Vol. 266.

Anderson, P. and Anderson, E. (2002): "The New E-Commerce Intermediaries", *MIT Sloan Management Review,* Vol. 43, No. 4, pp. 53-62.

Anenberg, S., Miller, J., Henze, D., and Minjares, R. (2019): "A Global Snapshot of the Air Pollution-Related Health Impacts of Transportation Sector Emissions in 2010 and 2015", *International Council on Clean Transportation*.

Backhaus, K., Erichson, B., and Weiber, R. (2015): *Fortgeschrittene Multivariate Analysemethoden: Eine anwendungsorientierte Einführung,* Springer Gabler, Berlin.

Bakos, Y. (1998): "The Emerging Role of Electronic Marketplaces on the Internet", *Communications of the ACM,* Vol. 41, No. 8, pp. 35-42.

Bardhi, F. and Eckhardt, G. M. (2012): "Access-Based Consumption: The Case of Car Sharing", *Journal of Consumer Research,* Vol. 39, No. 4, pp. 881-898.

Beck, A. (2011): "Experiences with Competitive Tendering of Bus Services in Germany", *Transport Reviews,* Vol. 31, No. 3, pp. 313-339.

Beirão, G. and Cabral, J. A. S. (2007): "Understanding Attitudes Towards Public Transport and Private Car: A Qualitative Study", *Transport Policy,* Vol. 14, pp. 478-489.

Benbasat, I., Goldstein, D. K., and Mead, M. (1987): "The Case Research Strategy in Studies of Information Systems", *MIS Quarterly,* Vol. 11, No. 3, pp. 369-386.

Benevolo, C., Dameri, R. P., and D'Auria, B. (2016): "Smart Mobility in Smart City: Action Taxonomy, ICT Intensity and Public Benefits", Torre, T., Braccini, A. M., and Spinelli, R., *Empowering Organizations: Enabling Platforms and Artefacts,* Springer, Cham. pp. 13-28.

Berger, B., Matt, C., Steininger, D. M., and Hess, T. (2015): "It Is Not Just About Competition with "Free": Differences between Content Formats in Consumer Preferences and Willingness to Pay", *Journal of Management Information Systems,* Vol. 32, No. 3, pp. 105-128.

Biddle, B. J. (1979): *Role Theory: Expectations, Identities, and Behaviors,* Academic Press, New York.

Böcker, L., Anderson, E., Uteng, T. P., and Throndsen, T. (2020): "Bike Sharing Use in Conjunction to Public Transport: Exploring Spatiotemporal, Age and Gender Dimensions in Oslo, Norway", *Transportation Research Part A: Policy and Practice,* Vol. 138, pp. 389-401.

Boero, M., Garré, M., Fernandez, J., Persi, S., Quesada, D., and Jakob, M. (2016): "MyWay Personal Mobility: From Journey Planners to Mobility Resource Management", *Transportation Research Procedia,* Vol. 14, pp. 1154-1163.

Bogner, A., Littig, B., and Menz, W. (2009): "Introduction: Expert Interviews - an Introduction to a New Methodological Debate", Bogner, A., Littig, B., and Menz, W., *Interviewing Experts,* Palgrave Macmillan, London. pp. 1-13.

Boote, D. N. and Beile, P. (2005): "Scholars before Researchers: On the Centrality of the Dissertation Literature Review in Research Preparation", *Educational Researcher,* Vol. 34, No. 6, pp. 3-15.

Brandstätter, G., Leitner, M., and Ljubić, I. (2020): "Location of Charging Stations in Electric Car Sharing Systems", *Transportation Science,* Vol. 54, No. 5, pp. 1408-1438.

Bratzel, S. (2018): "Junge Generation und die Mobilität der Zukunft".

Breidbach, C. F. and Maglio, P. P. (2016): "Technology-Enabled Value Co-Creation: An Empirical Analysis of Actors, Resources, and Practices", *Industrial Marketing Management,* Vol. 56, pp. 73–85.

Brendel, A. B., Brennecke, J. T., and Nastjuk, I. (2018): "Applying Econophysics in the Context of Carsharing - Development of a Vehicle Relocation Algorithm and Decision Support System", *International Conference on Information Systems*. San Francisco.

Brousseau, E. (2002): "The Governance of Transactions by Commercial Intermediaries: An Analysis of the Re-Engineering of Intermediation by Electronic Commerce", *International Journal of the Economics of Business,* Vol. 9, No. 3, pp. 353-374.

Brust, L., Breidbach, C. F., Antons, D., and Salge, T. O. (2017): "Service-Dominant Logic and Information Systems Research: A Review and Analysis Using Topic Modeling", *International Conference on Information Systems*. Seoul.

bsc Bundesverband CarSharing e.V. (2020): *Aktuelle Zahlen und Daten zum Carsharing in Deutschland*. URL: https://carsharing.de/alles-ueber-carsharing/carsharing-zahlen/aktuelle-zahlen-daten-zum-carsharing-deutschland (visited on 2020-10-08).

Buehler, R., Pucher, J., and Dümmler, O. (2019): "Verkehrsverbund: The Evolution and Spread of Fully Integrated Regional Public Transport in Germany, Austria, and Switzerland", *International Journal of Sustainable Transportation,* Vol. 13, No. 1, pp. 36-50.

Buehler, R., Pucher, J., Gerike, R., and Götschi, T. (2017): "Reducing Car Dependence in the Heart of Europe: Lessons from Germany, Austria, and Switzerland", *Transport Reviews,* Vol. 37, No. 1, pp. 4-28.

Burghard, U. and Dütschke, E. (2019): "Who Wants Shared Mobility? Lessons from Early Adopters and Mainstream Drivers on Electric Carsharing in Germany", *Transportation Research Part D: Transport and Environment,* Vol. 71, pp. 96-109.

Caiati, V., Rasouli, S., and Timmermans, H. (2020): "Bundling, Pricing Schemes and Extra Features Preferences for Mobility as a Service: Sequential Portfolio Choice Experiment", *Transportation Research Part A: Policy and Practice,* Vol. 131, pp. 123-148.

Callegati, F., Giallorenzo, S., Melis, A., and Prandini, M. (2017): "Insider Threats in Emerging Mobility-as-a-Service Scenarios", *Hawaii International Conference on System Sciences*.

Carlborg, P., Kindström, D., and Kowalkowski, C. (2014): "The Evolution of Service Innovation Research: A Critical Review and Synthesis", *The Service Industries Journal,* Vol. 34, No. 5, pp. 373-398.

Cerutti, P. S., Martins, R. D., Macke, J., and Sarate, J. A. R. (2019): "“Green, but Not as Green as That”: An Analysis of a Brazilian Bike-Sharing System”, *Journal of Cleaner Production,* Vol. 217, pp. 185-193.

Chandler, J. D. and Vargo, S. L. (2011): “Contextualization and Value-in-Context: How Context Frames Exchange”, *Marketing Theory,* Vol. 11, No. 1, pp. 35-49.

Chen, W., Mes, M., Schutten, M., and Quint, J. (2019): “A Ride-Sharing Problem with Meeting Points and Return Restrictions”, *Transportation Science,* Vol. 53, No. 2, pp. 401-426.

Choudhury, D. P. (2018): *Sustainability Management: Strategies and Execution for Achieving Responsible Organizational Goals,* Zorba Books, Gurgaon.

Circella, G., Alemi, F., Tiedeman, K., Berliner, R. M., Lee, Y., Fulton, L., Mokhtarian, P. L., and Handy, S. (2017): “What Affects Millennials’ Mobility? Part II: The Impact of Residential Location, Individual Preferences and Lifestyles on Young Adults' Travel Behavior in California”.

Cooper, H. M. (1988): “Organizing Knowledge Syntheses: A Taxonomy of Literature Reviews”, *Knowledge in Society,* Vol. 1.

Dacin, M. T., Oliver, C., and Roy, J. P. (2007): “The Legitimacy of Strategic Alliances: An Institutional Perspective”, *Strategic Management Journal,* Vol. 28, No. 2, pp. 169-187.

Datner, S., Raviv, T., Tzur, M., and Chemla, D. (2019): “Setting Inventory Levels in a Bike Sharing Network”, *Transportation Science,* Vol. 53, No. 1, pp. 62-76.

Dibben, P. (2006): “The ‘Socially Excluded’ and Local Transport Decision Making: Voice and Responsiveness in a Marketized Environment”, *Public Administration,* Vol. 84, No. 3, pp. 655-672.

DiMaggio, P. J. and Powell, W. W. (1983): “The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields”, *American Sociological Review,* Vol. 48, No. 2, pp. 147-160.

Dionne, P. and Bourdon, S. (2018): “Contradictions as the Driving Force of Collective and Subjective Development Group Employment Programmes”, *Journal of Education and Work,* Vol. 31, No. 3, pp. 277-290.

Docherty, I., Marsden, G., and Anable, J. (2018): “The Governance of Smart Mobility”, *Transportation Research Part A,* Vol. 115, pp. 114-125.

Dolan, R., Seo, Y., and Kemper, J. (2019): “Complaining Practices on Social Media in Tourism: A Value Co-Creation and Co-Destruction Perspective”, *Tourism Management,* Vol. 73, pp. 35-45.

Dotoli, M., Zgaya, H., Russo, C., and Hammadi, S. (2017): “A Multi-Agent Advanced Traveler Information System for Optimal Trip Planning in a Co-Modal Framework”, *IEEE Transactions on Intelligent Transportation Systems,* Vol. 18, No. 9, pp. 2397-2412.

Draebye, M. (2019): *Start-up Entrepreneurship: The Smart Way,* EGEA, Milano.

Drake, D. F., Kleindorfer, P. R., and van Wassenhove, L. N. (2016): "Technology Choice and Capacity Portfolios under Emissions Regulation", *Production and Operations Management,* Vol. 25, No. 6, pp. 1006-1025.

Eisenhardt, K. M. (1989): "Building Theories from Case Study Research", *Academy of Management Review,* Vol. 14, No. 4, pp. 532-550.

Emerson, R. M. (1962): "Power-Dependence Relations", *American Sociological Review,* Vol. 27, No. 1, pp. 31-41.

Engeström, Y. (1987): *Learning by Expanding: An Activity-Theoretical Approach to Developmental Research,* Orienta-Konsultit, Helsinki.

Engeström, Y. (2001): "Expansive Learning at Work: Toward an Activity Theoretical Reconceptualization", *Journal of Education and Work,* Vol. 14, No. 1, pp. 133-156.

Ericsson, K. A. (2006): "The Cambridge Handbook of Expertise and Expert Performance", Ericsson, K. A., Charness, N., Feltovich, P. J., and Hoffman, R. R., *An Introduction to the Cambridge Handbook of Expertise and Expert Performance: Its Development, Organization and Content,* Cambridge University Press, Cambridge. pp. 3-19.

Eurostat (2020): *Erste Bevölkerungsschätzungen. EU-Bevölkerung im Jahr 2020 bei fast 448 Millionen. Mehr Sterbefälle als Geburten.* URL: https://ec.europa.eu/eurostat/documents/2995521/11081097/3-10072020-AP-DE.pdf/7f863daa-c1ac-758f-e82b-954726c4621f (visited on 2020-10-08).

Faulk, D. and Hicks, M. (2010): "The Economic Effects of Bus Transit in Small Cities", *Public Finance Review,* Vol. 38, No. 5, pp. 513-539.

Feilzer, M. Y. (2010): "Doing Mixed Methods Research Pragmatically: Implications for the Rediscovery of Pragmatism as a Research Paradigm", *Journal of Mixed Methods Research,* Vol. 4, No. 1, pp. 6-16.

Firnkorn, J. and Müller, M. (2011): "What Will Be the Environmental Effects of New Free-Floating Car-Sharing Systems? The Case of Car2go in Ulm", *Ecological Economics,* Vol. 70, No. 8, pp. 1519-1528.

Firnkorn, J. and Müller, M. (2012): "Selling Mobility Instead of Cars: New Business Strategies of Automakers and the Impact on Private Vehicle Holding", *Business Strategy and the Environment,* Vol. 21, No. 4, pp. 264-280.

Firnkorn, J. and Shaheen, S. (2016): "Generic Time- and Method-Interdependencies of Empirical Impact-Measurements: A Generalizable Model of Adaptation-Processes of Carsharing-Users' Mobility-Behavior over Time", *Journal of Cleaner Production,* Vol. 113, pp. 897-909.

Fiss, P. C. (2011): "Building Better Causal Theories: A Fuzzy Set Approach to Typologies in Organization Research", *Academy of Management Journal,* Vol. 54, No. 2, pp. 393-420.

Flick, U. (2009): *An Introduction to Qualitative Research,* SAGE Publications, London.

Follmer, R. and Gruschwitz, D. (2019): "Mobilität in Deutschland - MiD Kurzreport".

Fontana, A. and Frey, J. H. (1994): “Interviewing: The Art of Science”, Denzin, N. K., and Lincoln, Y. S., *Handbook of Qualitative Research*, SAGE Publications, Thousand Oaks. pp. 361-376.

Frade, I. and Ribeiro, A. (2015): “Bike-Sharing Stations: A Maximal Covering Location Approach”, *Transportation Research Part A: Policy and Practice,* Vol. 82, pp. 216-227.

Franco, P., Johnston, R., and McCormick, E. (2020): “Demand Responsive Transport: Generation of Activity Patterns from Mobile Phone Network Data to Support the Operation of New Mobility Services”, *Transportation Research Part A: Policy and Practice,* Vol. 131, pp. 244-266.

Gagnepain, P. and Ivaldi, M. (2017): “Economic Efficiency and Political Capture in Public Service Contracts”, *The Journal of Industrial Economics,* Vol. 65, No. 1, pp. 1-38.

Galbraith, J. K. (1993): *American Capitalism: The Concept of Countervailing Power*, Routledge, New York.

Gallego, F., Montero, J.-P., and Salas, C. (2013): “The Effect of Transport Policies on Car Use: Evidence from Latin American Cities”, *Journal of Public Economics,* Vol. 107, pp. 47-62.

Gebauer, H., Johnson, M., and Enquist, B. (2010): “Value Co-Creation as a Determinant of Success in Public Transport Services: A Study of the Swiss Federal Railway Operator (SBB)”, *Managing Service Quality,* Vol. 20, No. 6, pp. 511-530.

Giaglis, G. M., Klein, S., and O'Keefe, R. M. (2002): “The Role of Intermediaries in Electronic Marketplaces: Developing a Contingency Model”, *Information Systems Journal,* Vol. 12, No. 3, pp. 231-246.

Giesecke, R., Surakka, T., and Hakonen, M. (2016): “Conceptualising Mobility as a Service: A User Centric View on Key Issues of Mobility Services”, *Conference on Ecological Vehicles and Renewable Energies*. Monte Carlo.

Giffinger, R. and Haindlmaier, G. (2010): “Smart Cities Ranking: An Effective Instrument for the Positioning of the Cities?”, *ACE: Architecture, City and Environment,* Vol. 4, No. 12, pp. 7-26.

Gijsenberg, M. J. and Verhoef, P. C. (2019): “Moving Forward: The Role of Marketing in Fostering Public Transport Usage”, *Journal of Public Policy & Marketing,* Vol. 38, No. 3, pp. 354-371.

Gilsing, R., Turetken, O., Adali, O. E., and Grefen, P. (2018): “A Reference Model for the Design of Service-Dominant Business Models in the Smart Mobility Domain”, *International Conference on Information Systems*. San Francisco.

Gläser, J. and Laudel, G. (2010): *Experteninterviews und qualitative Inhaltsanalyse als Instrumente rekonstruierender Untersuchungen*, VS Verlag für Sozialwissenschaften, Wiesbaden.

Goerigk, M., Schmidt, M., Schöbel, A., Knoth, M., and Müller-Hannemann, M. (2014): "The Price of Strict and Light Robustness in Timetable Information", *Transportation Science,* Vol. 48, No. 2, pp. 225-242.

Gogos, S. and Letellier, X. (2016): "IT2Rail: Information Technologies for Shift to Rail", *Transportation Research Procedia,* Vol. 14, pp. 3218-3227.

Goldkuhl, G. (2012): "Pragmatism vs Interpretivism in Qualitative Information Systems Research", *European Journal of Information Systems,* Vol. 21, No. 2, pp. 135-146.

Gray, W. B. and Shadbegian, R. J. (1998): "Environmental Regulation, Investment Timing, and Technology Choice", *The Journal of Industrial Economics,* Vol. 46, No. 2, pp. 235-256.

Greckhamer, T., Furnari, S., Fiss, P. C., and Aguilera, R. V. (2018): "Studying Configurations with Qualitative Comparative Analysis: Best Practices in Strategy and Organization Research", *Strategic Organization,* Vol. 16, No. 4, pp. 482-495.

Gretzel, U., Sigala, M., Xiang, Z., and Koo, C. (2015): "Smart Tourism: Foundations and Developments", *Electronic Markets,* Vol. 25, No. 3, pp. 179-188.

Grinevich, V., Huber, F., Karataş-Özkan, M., and Yavuz, Ç. (2019): "Green Entrepreneurship in the Sharing Economy: Utilising Multiplicity of Institutional Logics", *Small Business Economics,* Vol. 52, No. 4, pp. 859-876.

Gross, S. and Grimm, B. (2018): "Sustainable Mode of Transport Choices at the Destination – Public Transport at German Destinations", *Tourism Review,* Vol. 73, No. 3.

Grotenhuis, J.-W., Wiegmans, B. W., and Rietveld, P. (2007): "The Desired Quality of Integrated Multimodal Travel Information in Public Transport: Customer Needs for Time and Effort Savings", *Transport Policy,* Vol. 14, No. 1, pp. 27-38.

Groth, S. (2019): "Multimodal Divide: Reproduction of Transport Poverty in Smart Mobility Trends", *Transportation Research Part A: Policy and Practice,* Vol. 125, pp. 56-71.

Hahn, R., Ostertag, F., Lehr, A., Büttgen, M., and Benoit, S. (2020): ""I Like It, but I Don't Use It": Impact of Carsharing Business Models on Usage Intentions in the Sharing Economy", *Business Strategy and the Environment,* Vol. 29, No. 3, pp. 1404-1418.

Hair Jr., J. F., Black, W. C., Babin, B. J., and Anderson, R. E. (2014): *Multivariate Data Analysis,* Pearson Education, Harlow.

Hall, R. (2013): "Mixed Methods: In Search of a Paradigm", Le, T., and Lê, Q., *Conducting Research in a Changing and Challenging World,* Nova Science Publishers, New York. pp. 71-81.

Hamidi, Z., Camporeale, R., and Caggiani, L. (2019): "Inequalities in Access to Bike-and-Ride Opportunities: Findings for the City of Malmö", *Transportation Research Part A: Policy and Practice,* Vol. 130, pp. 673-688.

Hart, C. (1998): *Doing a Literature Review: Releasing the Social Science Research Imagination,* SAGE Publications, London.

Hasan, H., Smith, S., and Finnegan, P. (2017): "An Activity Theoretic Analysis of the Mediating Role of Information Systems in Tackling Climate Change Adaptation", *Information Systems Journal,* Vol. 27, No. 3, pp. 271-308.

Haywood, L., Koning, M., and Monchambert, G. (2017): "Crowding in Public Transport: Who Cares and Why?", *Transportation Research Part A: Policy and Practice,* Vol. 100, pp. 215-227.

Hein, A., Scheiber, M., Böhm, M., Weking, J., Rocznik, D., and Krcmar, H. (2018): "Toward a Design Framework for Service-Platform Ecosystems", *European Conference on Information Systems*. Portsmouth.

Hildebrandt, B., Hanelt, A., and Firk, S. (2018): "Sharing yet Caring: Mitigating Moral Hazard in Access-Based Consumption through IS-Enabled Value Co-Capturing with Consumers", *Business & Information Systems Engineering,* Vol. 60, No. 3, pp. 227-241.

Hildebrandt, B., Hanelt, A., Piccinini, E., Kolbe, L. M., and Nierobisch, T. (2015): "The Value of IS in Business Model Innovation for Sustainable Mobility Services - the Case of Carsharing", *International Conference on Wirtschaftsinformatik*. Osnabrück.

Hodder, I. (1994): "The Interpretation of Documents and Material Culture", Denzin, N. K., and Lincoln, Y. S., *Handbook of Qualitative Research,* SAGE Publications, Thousand Oaks. pp. 393-402.

Hoerstebrock, T. and Hahn, A. (2014): "An Approach Towards Service Infrastructure Optimization for Electromobility", Hülsmann, M., and Fornahl, D., *Evolutionary Paths Towards the Mobility Patterns of the Future,* Springer, Berlin. pp. 265-280.

Hoogendoorn-Lanser, S., van Nes, R., Hoogendoorn, S. P., and Bovy, P. (2006): "Home-Activity Approach to Multimodal Travel Choice Modeling", *Transportation Research Record: Journal of the Transportation Research Board,* Vol. 1985, No. 1, pp. 180-187.

Hrncir, J. and Jakob, M. (2013): "Generalised Time-Dependent Graphs for Fully Multimodal Journey Planning", *International IEEE Conference on Intelligent Transportation Systems*. The Hague.

INRIX (2020): *INRIX Verkehrsstudie: Stau verursacht Kosten in Milliardenhöhe*. URL: https://inrix.com/press-releases/2019-traffic-scorecard-german/ (visited on 2020-10-08).

Jarzabkowski, P. (2003): "Strategic Practices: An Activity Theory Perspective on Continuity and Change", *Journal of Management Studies,* Vol. 40, No. 1, pp. 23-55.

Jasperson, J. S., Carte, T. A., Saunders, C. S., Butler, B. S., Croes, H. J. P., and Zheng, W. (2002): "Review: Power and Information Technology Research: A Metatriangulation Review", *MIS Quarterly,* Vol. 26, No. 4, pp. 397-459.

Jin, J. G., Teo, K. M., and Odoni, A. R. (2016): "Optimizing Bus Bridging Services in Response to Disruptions of Urban Transit Rail Networks", *Transportation Science,* Vol. 50, No. 3, pp. 790–804.

Jittrapirom, P., Caiati, V., Feneri, A.-M., Ebrahimigharehbaghi, S., Alonso-González, M. J., and Narayan, J. (2017): "Mobility as a Service: A Critical Review of Definitions, Assessments of Schemes, and Key Challenges", *Urban Planning,* Vol. 2, No. 2, pp. 13-25.

Jones, W. B., Cassady, C. R., and Bowden Jr., R. O. (2000): "Developing a Standard Definition of Intermodal Transportation", *Transportation Law Journal,* Vol. 27, No. 3, pp. 345-352.

Kaushik, V. and Walsh, C. A. (2019): "Pragmatism as a Research Paradigm and Its Implications for Social Work Research", *Social Sciences,* Vol. 8, No. 9.

Kirpes, B. and Becker, C. (2018): "Processing Electric Vehicle Charging Transactions in a Blockchain-Based Information System", *Americas Conference on Information Systems*. New Orleans.

Klievink, B., Romijn, B.-J., Cunningham, S., and de Bruijn, H. (2017): "Big Data in the Public Sector: Uncertainties and Readiness", *Information Systems Frontiers,* Vol. 19, pp. 267-283.

Klingen, J. (2019): "Do Metro Interruptions Increase the Demand for Public Rental Bicycles? Evidence from Paris", *Transportation Research Part A: Policy and Practice,* Vol. 123, pp. 216-228.

Klischewski, R. and Ukena, S. (2009): "A Value Network Analysis of Automated Access to E-Government Services", *International Conference on Wirtschaftsinformatik*. Wien.

Koch, H. and Schultze, U. (2011): "Stuck in the Conflicted Middle. A Role-Theoretic Perspective on B2B E-Marketplaces", *MIS Quarterly,* Vol. 35, No. 1, pp. 123-146.

Kohtamäki, M. and Rajala, R. (2016): "Theory and Practice of Value Co-Creation in B2B Systems", *Industrial Marketing Management,* Vol. 56, pp. 4-13.

Koskela-Huotari, K., Edvardsson, B., Jonas, J. M., Sörhammar, D., and Witell, L. (2016): "Innovation in Service Ecosystems—Breaking, Making, and Maintaining Institutionalized Rules of Resource Integration", *Journal of Business Research,* Vol. 69, No. 8, pp. 2964-2971.

Kotler, P. and Armstrong, G. (2010): *Principles of Marketing,* Pearson Education, Upper Saddle River.

Kraftfahrt-Bundesamt (2020): *Jahresbilanz der Neuzulassungen 2018*. URL: https://www.kba.de/DE/Statistik/Fahrzeuge/Neuzulassungen/n_jahresbilanz.html (visited on 2020-09-22).

Kuhnimhof, T., Armoogum, J., Buehler, R., Dargay, J., Denstadli, J. M., and Yamamoto, T. (2012): "Men Shape a Downward Trend in Car Use among Young Adults—Evidence from Six Industrialized Countries", *Transport Reviews,* Vol. 32, No. 6, pp. 761-779.

Kuutti, K. (1996): "Activity Theory as a Potential Framework for Human-Computer Interaction Research", Nardi, B. A., *Context and Consciousness. Activity Theory and Human-Computer Interaction,* Massachusetts Institute of Technology, London. pp. 17-44.

Laakso, S. (2017): "Giving up Cars – the Impact of a Mobility Experiment on Carbon Emissions and Everyday Routines", *Journal of Cleaner Production,* Vol. 169, pp. 135-142.

Laud, G., Bove, L., Ranaweera, C., Leo, W. W. C., Sweeney, J., and Smith, S. (2019): "Value Co-Destruction: A Typology of Resource Misintegration Manifestations", *Journal of Services Marketing,* Vol. 33, No. 7, pp. 866-889.

Laurischkat, K. and Jandt, D. (2018): "Techno-Economic Analysis of Sustainable Mobility and Energy Solutions Consisting of Electric Vehicles, Photovoltaic Systems and Battery Storages", *Journal of Cleaner Production,* Vol. 179, pp. 642-661.

Leland, S. and Smirnova, O. (2009): "Reassessing Privatization Strategies 25 Years Later: Revisiting Perry and Babitsky's Comparative Performance Study of Urban Bus Transit Services", *Public Administration Review,* Vol. 69, No. 5, pp. 855-867.

Leont'ev, A. N. (1978): *Activity, Consciousness, and Personality,* Prentice-Hall, Englewood Cliffs, New Jersey.

Leroi-Werelds, S. (2019): "An Update on Customer Value: State of the Art, Revised Typology, and Research Agenda", *Journal of Service Management,* Vol. 30, No. 5, pp. 650-680.

Li, R., Nie, Y. M., and Liu, X. (2020): "Pricing Carpool Rides Based on Schedule Displacement", *Transportation Science,* Vol. 54, No. 4, pp. 1134-1152.

Li, W. and Kamargianni, M. (2020), "An Integrated Choice and Latent Variable Model to Explore the Influence of Attitudinal and Perceptual Factors on Shared Mobility Choices and Their Value of Time Estimation", *Transportation Science,* Vol. 54, No. 1, pp. 62-83.

Liu, Y., Guo, H., and Nault, B. (2013): "Technology, Interoperability, and Provision of Public Safety Networks", *International Conference on Information Systems*. Milan.

Liu, Y., Hong, Z., and Liu, Y. (2016): "Do Driving Restriction Policies Effectively Motivate Commuters to Use Public Transportation?", *Energy Policy,* Vol. 90, pp. 253-261.

Lodi, A., Malaguti, E., Stier-Moses, N. E., and Bonino, T. (2016): "Design and Control of Public-Service Contracts and an Application to Public Transportation Systems", *Management Science,* Vol. 62, No. 4, pp. 1165-1187.

Luce, R. D. and Tukey, J. W. (1964): "Simultaneous Conjoint Measurement: A New Type of Fundamental Measurement", *Journal of Mathematical Psychology,* Vol. 1, No. 1, pp. 1-27.

Lusch, R. F. and Nambisan, S. (2015): "Service Innovation: A Service-Dominant Logic Perspective", *MIS Quarterly,* Vol. 39, No. 1, pp. 155-175.

Lyons, G., Hammond, P., and Mackay, K. (2020): "Reprint Of: The Importance of User Perspective in the Evolution of MaaS", *Transportation Research Part A: Policy and Practice,* Vol. 131, pp. 20-34.

Ma, Y., Lan, J., Thornton, T., Mangalagiu, D., and Zhu, D. (2018): "Challenges of Collaborative Governance in the Sharing Economy: The Case of Free-Floating Bike Sharing in Shanghai", *Journal of Cleaner Production,* Vol. 197, No. 1, pp. 356-365.

Mahéo, A., Kilby, P., and van Hentenryck, P. (2019): "Benders Decomposition for the Design of a Hub and Shuttle Public Transit System", *Transportation Science,* Vol. 53, No. 1, pp. 77-88.

Malaurent, J. and Karanasios, S. (2020): "Learning from Workaround Practices: The Challenge of Enterprise System Implementations in Multinational Corporations", *Information Systems Journal,* Vol. 30, No. 4, pp. 639-663.

Maloni, M. and Benton, W. C. (2000): "Power Influences in the Supply Chain", *Journal of Business Logistics,* Vol. 21, No. 1, pp. 49-73.

Malthouse, E. C., Buoye, A., Line, N., El-Manstrly, D., Dogru, T., and Kandampully, J. (2019): "Beyond Reciprocal: The Role of Platforms in Diffusing Data Value across Multiple Stakeholders", *Journal of Service Management,* Vol. 30, No. 4, pp. 507-518.

Mantin, B. and Rubin, E. (2016): "Fare Prediction Websites and Transaction Prices: Empirical Evidence from the Airline Industry", *Marketing Science,* Vol. 35, No. 4, pp. 640-655.

March, J. G. (1966): "The Power of Power", Easton, D., *Varieties of Political Theory,* Prentice-Hall, Englewood Cliffs. pp. 39-70.

Marx, R., de Mello, A. M., Zilbovicius, M., and de Lara, F. F. (2015): "Spatial Contexts and Firm Strategies: Applying the Multilevel Perspective to Sustainable Urban Mobility Transitions in Brazil", *Journal of Cleaner Production,* Vol. 108, pp. 1092-1104.

Masuch, N., Lützenberger, M., and Keiser, J. (2013): "An Open Extensible Platform for Intermodal Mobility Assistance", *Procedia Computer Science,* Vol. 19, pp. 396-403.

Mauksch, S., von der Gracht, H. A., and Gordon, T. J. (2020): "Who Is an Expert for Foresight? A Review of Identification Methods", *Technological Forecasting and Social Change,* Vol. 154.

Maxwell, J. A. and Mittapalli, K. (2010): "Realism as a Stance for Mixed Methods Research", Tashakkori, A., and Teddlie, C., *Sage Handbook of Mixed Methods in Social and Behavioral Research,* SAGE Publications, Thousand Oaks. pp. 145-168.

McCubbrey, D. J. (1999): "Disintermediation and Reintermediation in the U.S. Air Travel Distribution Industry: A Delphi Study", *Communications of the Association for Information Systems,* Vol. 1.

McCubbrey, D. J. and Taylor, R. G. (2005): "Disintermediation and Reintermediation in the U.S. Air Travel Distribution Industry: A Delphi Reprise", *Communications of the Association for Information Systems,* Vol. 15.

Merton, R. K. (1957): "The Role-Set: Problems in Sociological Theory", *The British Journal of Sociology,* Vol. 8, No. 2, pp. 106-120.

Merton, R. K. and Kendall, P. L. (1946): “The Focused Interview”, *American Journal of Sociology,* Vol. 51, No. 6, pp. 541-557.

Meyer, J. W. and Rowan, B. (1977): “Institutionalized Organizations: Formal Structure as Myth and Ceremony”, *American Journal of Sociology,* Vol. 83, No. 2, pp. 340-363.

Mignerat, M. and Rivard, S. (2009): “Positioning the Institutional Perspective in Information Systems Research”, *Journal of Information Technology,* Vol. 24, No. 4, pp. 369-391.

Morgan, D. L. (2007): “Paradigms Lost and Pragmatism Regained: Methodological Implications of Combining Qualitative and Quantitative Methods”, *Journal of Mixed Methods Research,* Vol. 1, No. 1, pp. 48-76.

Morgan, D. L. (2014): *Integrating Qualitative and Quantitative Methods: A Pragmatic Approach,* SAGE Publications, Los Angeles.

Motta, G., Sacco, D., Ma, T., You, L., and Liu, K. (2015): “Personal Mobility Service System in Urban Areas: The IRMA Project”, *IEEE Symposium on Service-Oriented System Engineering*. San Francisco Bay.

Mouwen, A. (2015): “Drivers of Customer Satisfaction with Public Transport Services”, *Transportation Research Part A: Policy and Practice,* Vol. 78, pp. 1-20.

Münchner Kreis e.V. (2017): “Mobility. Fulfilment. System: On the Future of Mobility 2025+”.

Myers, M. D. (2020): *Qualitative Research in Business and Management,* SAGE Publications, Thousand Oaks.

Myers, M. D. and Newman, M. (2007): “The Qualitative Interview in IS Research: Examining the Craft”, *Information and Organization,* Vol. 17, No. 1, pp. 2-26.

Naous, D. and Legner, C. (2017): “Leveraging Market Research Techniques in IS – a Review of Conjoint Analysis in IS Research”, *International Conference on Information Systems*. Seoul.

Nijland, H. and van Meerkerk, J. (2017): “Mobility and Environmental Impacts of Car Sharing in the Netherlands”, *Environmental Innovation and Societal Transitions,* Vol. 23, pp. 84-91.

Nobis, C. (2007): “Multimodality: Facets and Causes of Sustainable Mobility Behavior”, *Transportation Research Record: Journal of the Transportation Research Board,* Vol. 2010, No. 1, pp. 35-44.

North, D. C. (1990): *Institutions, Institutional Change and Economic Performance,* Cambridge University Press.

Nunes, A. A., Galvão, T., and e Cunha, J. F. (2014): “Urban Public Transport Service Co-Creation: Leveraging Passenger's Knowledge to Enhance Travel Experience”, *Procedia - Social and Behavioral Sciences,* Vol. 111, No. 5, pp. 577-585.

Okwechime, E., Duncan, P., and Edgar, D. (2018): "Big Data and Smart Cities: A Public Sector Organizational Learning Perspective", *Information Systems and e-Business Management*, Vol. 16, pp. 601-625.

Ordanini, A., Parasuraman, A., and Rubera, G. (2014): "When the Recipe Is More Important Than the Ingredients: A Qualitative Comparative Analysis (QCA) of Service Innovation Configurations", *Journal of Service Research*, Vol. 17, No. (2), pp. 134-149.

Osborne, S. P. (2018): "From Public Service-Dominant Logic to Public Service Logic: Are Public Service Organizations Capable of Co-Production and Value Co-Creation?", *Public Management Review*, Vol. 20, No. 2, pp. 225-231.

Osborne, S. P., Radnor, Z., and Nasi, G. (2013): "A New Theory for Public Service Management? Toward a (Public) Service-Dominant Approach", *American Review of Public Administration*, Vol. 43, No. 2, pp. 135-158.

Paik, Y., Kang, S., and Seamans, R. (2019): "Entrepreneurship, Innovation, and Political Competition: How the Public Sector Helps the Sharing Economy Create Value", *Strategic Management Journal*, Vol. 40, No. 4, pp. 503-532.

Pankov, S., Velamuri, V. K., and Schneckenberg, D. (2019): "Towards Sustainable Entrepreneurial Ecosystems: Examining the Effect of Contextual Factors on Sustainable Entrepreneurial Activities in the Sharing Economy", *Small Business Economics*.

Pappas, I. O., Mikalef, P., Giannakos, M. N., Krogstie, J., and Lekakos, G. (2018): "Big Data and Business Analytics Ecosystems: Paving the Way Towards Digital Transformation and Sustainable Societies", *Information Systems and e-Business Management*, Vol. 16, No. 3, pp. 479-491.

Payne, A. F., Storbacka, K., and Frow, P. (2008): "Managing the Co-Creation of Value", *Journal of the Academy of Marketing Science*, Vol. 36, No. 1, pp. 83-96.

Petersen, H. L., Larsen, A., Madsen, O. B. G., Petersen, B., and Ropke, S. (2013): "The Simultaneous Vehicle Scheduling and Passenger Service Problem", *Transportation Science*, Vol. 47, No. 4, pp. 603-616.

Peterson, M. and Simkins, T. (2019): "Consumers' Processing of Mindful Commercial Car Sharing", *Business Strategy and the Environment*, Vol. 28, No. 3, pp. 457-465.

Pfaff, S. (2012): "Pendeln oder umziehen? Mobilitätsentscheidungen in Deutschland zwischen 2000 und 2009", *Zeitschrift für Soziologie*, Vol. 41, No. 6, pp. 458-477.

Pfeffer, J. and Moore, W. L. (1980): "Power in University Budgeting: A Replication and Extension", *Administrative Science Quarterly*, Vol. 25, No. 4, pp. 637-653.

Plé, L. (2016): "Studying Customers' Resource Integration by Service Employees in Interactional Value Co-Creation", *Journal of Services Marketing*, Vol. 30, No. 2, pp. 152-164.

Plé, L. and Cáceres, R. C. (2010): "Not Always Co-Creation: Introducing Interactional Co-Destruction of Value in Service-Dominant Logic", *Journal of Services Marketing*, Vol. 24, No. 6, pp. 430-437.

Prandtstetter, M., Straub, M., and Puchinger, J. (2013): "On the Way to a Multi-Modal Energy-Efficient Route", *Conference of the IEEE Industrial Electronics Society*. Vienna.

Provan, K. G., Kenis, P., and Human, S. E. (2015): "Legitimacy Building in Organizational Networks", Bingham, L. B., and Rosemary, O. L., *Big Ideas in Collaborative Public Management,* Routledge, New York. pp. 121-137.

Raghuram, S., Tuertscher, P., and Garud, R. (2010): "Research Note - Mapping the Field of Virtual Work: A Cocitation Analysis", *Information Systems Research,* Vol. 21, No. 4, pp. 983-999.

Ragin, C. C. (2008): *Redesigning Social Inquiry: Fuzzy Sets and Beyond*, University of Chicago Press, Chicago.

Randhawa, K. and Scerri, M. (2015): "Service Innovation: A Review of the Literature", Agarwal, R., Selen, W., Roos, G., and Green, R., *The Handbook of Service Innovation,* Springer, London. pp. 27-51.

Rayle, L., Shaheen, S., Chan, N., Dai, D., and Cervero, R. (2014): "App-Based, on-Demand Ride Services: Comparing Taxi and Ridesourcing Trips and User Characteristics in San Francisco".

Rehm, S., Faber, A., and Goel, L. (2017): "Visualizing Platform Hubs of Smart City Mobility Business Ecosystems", *International Conference on Information Systems*, Seoul.

Reypens, C., Lievens, A., and Blazevic, V. (2016): "Leveraging Value in Multi-Stakeholder Innovation Networks: A Process Framework for Value Co-Creation and Capture", *Industrial Marketing Management,* Vol. 56, pp. 40-50.

Rihoux, B. and Ragin, C. C. (2009): *Configurational Comparative Methods: Qualitative Comparative Analysis (QCA) and Related Techniques,* SAGE Publications, Los Angeles.

Rivard, S. and Lapointe, L. (2012): "Information Technology Implementers' Responses to User Resistance: Nature and Effects", *MIS Quarterly,* Vol. 36, No. 3, pp. 897-920.

Sarkar, M. B., Butler, B., and Steinfield, C. (1995): "Intermediaries and Cybermediaries: A Continuing Role for Mediating Players in the Electronic Marketplace", *Journal of Computer-Mediated Communication,* Vol. 1, No. 3.

Sarker, R. I., Mailer, M., and Sikder, S. K. (2020): "Walking to a Public Transport Station: Empirical Evidence on Willingness and Acceptance in Munich, Germany", *Smart and Sustainable Built Environment,* Vol. 9, No. 1, pp. 38-53.

Sattler, H. and Hartmann, A. (2008): "Commercial Use of Conjoint Analysis", Höck, M., and Kai-Ingo, V., *Operations Management in Theorie und Praxis,* Gabler, Wiesbaden. pp. 103-119.

Schikofsky, J., Dannewald, T., and Kowald, M. (2020): "Exploring Motivational Mechanisms Behind the Intention to Adopt Mobility as a Service (MaaS): Insights from Germany", *Transportation Research Part A: Policy and Practice,* Vol. 131, pp. 296-312.

Schneider, C. Q. and Wagemann, C. (2007): *Qualitative Comparative Analysis (QCA) und Fuzzy Sets. Ein Lehrbuch für Anwender und jene, die es werden wollen*, Barbara Budrich, Opladen.

Schoenau, M. and Müller, M. (2017): "What Affects Our Urban Travel Behavior? A GPS-Based Evaluation of Internal and External Determinants of Sustainable Mobility in Stuttgart (Germany)", *Transportation Research Part F: Traffic Psychology and Behaviour,* Vol. 48, pp. 61-73.

Schreieck, M., Pflügler, C., Setzke, D. S., Wiesche, M., and Krcmar, H. (2018): "Improving Urban Transportation: An Open Platform for Digital Mobility Services", Linnhoff-Popien, C., Schneider, R., and Zaddach, M.: *Digital Marketplaces Unleashed,* Springer, Berlin. pp. 479-489.

Schreieck, M., Wiesche, M., and Krcmar, H. (2016): "Modularization of Digital Services for Urban Transportation", *Americas Conference on Information Systems*. San Diego.

Schröder, J.-O., Weiß, C., Kagerbauer, M., Reiß, N., Reuter, C., Schürmann, R., and Pfisterer, S. (2014): "Developing and Evaluating Intermodal E-Sharing Services – a Multi-Method Approach", *Transportation Research Procedia,* Vol. 4, pp. 199-212.

Schulz, T., Böhm, M., and Gewald, H. (2020a): "Information Technology Choice in Mobility Service Ecosystems: A Qualitative Comparative Analysis", *International Conference on Information Systems*. Hyderabad.

Schulz, T., Böhm, M., Gewald, H., Celik, Z., and Krcmar, H. (2020b): "The Negative Effects of Institutional Logic Multiplicity on Service Platforms in Intermodal Mobility Ecosystems", *Business & Information Systems Engineering,* Vol. 62, No. 5, pp. 417–433.

Schulz, T., Böhm, M., Gewald, H., and Krcmar, H. (2019): "Door-to-Door Mobility Integrators as Keystone Organizations of Smart Ecosystems: Resources and Value Co-Creation – a Literature Review", *International Conference on Wirtschaftsinformatik*. Siegen.

Schulz, T., Böhm, M., Gewald, H., and Krcmar, H. (2021a): "Smart Mobility – an Analysis of Potential Customers' Preference Structures", *Electronic Markets,* Vol. 31, No. 1, pp. 105–124.

Schulz, T., Gewald, H., and Böhm, M. (2018): "The Long and Winding Road to Smart Integration of Door-to-Door Mobility Services: An Analysis of the Hindering Influence of Intra-Role Conflicts", *European Conference on Information Systems*. Portsmouth.

Schulz, T., Gewald, H., Böhm, M., and Krcmar, H. (2020c): "Smart Mobility: Contradictions in Value Co-Creation", *Information Systems Frontiers*.

Schulz, T. and Ikonomou, G. (2020): "How Countervailing Power Affects Value Co-Creation among Service Providers: A Comparison of the Travel and Mobility Sectors", *Pacific Asia Conference on Information Systems,* Dubai.

Schulz, T. and Überle, M. (2018): "How Institutional Arrangements Impede Realization of Smart Ecosystems: The Case of Door-to-Door Mobility Integrators", *European Conference on Information Systems*. Portsmouth.

Schulz, T., Zimmermann, S., Böhm, M., Gewald, H., and Krcmar, H. (2021b): "Value Co-Creation and Co-Destruction in Service Ecosystems: The Case of the Reach Now App", *Technological Forecasting & Social Change*.

Schütt, P. (2015): *Der Weg zum Digitalen Unternehmen: Social Business Methoden erfolgreich einsetzen*, Springer-Verlag, Berlin.

Shaheen, S. A., Cohen, A. P., and Chung, M. S. (2009): "North American Carsharing: 10-Year Retrospective", *Transportation Research Record: Journal of the Transportation Research Board*, Vol. 2110, No. 1, pp. 35-44.

Shugan, S. M., Moon, J., Shi, Q., and Kumar, N. S. (2017): "Product Line Bundling: Why Airlines Bundle High-End While Hotels Bundle Low-End", *Marketing Science*, Vol. 36, No. 1, pp. 124-139.

Sigala, M. (2018): "Value Co-Destruction in Service Ecosystems: Findings from TripAdvisor", Sigala, M., and Gretzel, U., *Advances in Social Media for Travel, Tourism and Hospitality: New Perspectives, Practice and Cases*, Routledge, New York.

Silk, A. J. (2006): *What Is Marketing?*, Harvard Business School Press, Boston.

Simeonova, B., Karanasios, S., Galliers, R. D., Kelly, P. R., and Mishra, J. (2018): "Where Is Power in Information Systems Research? Towards a Framework", *International Conference on Information Systems*. San Francisco.

Skoglund, T. and Karlsson, I. C. M. (2012): "Appreciated–but with a Fading Grace of Novelty! Traveller's Assessment of, Usage of and Behavioural Change Given Access to a Co-Modal Travel Planner", *Procedia - Social and Behavioral Sciences*, Vol. 48, pp. 932-940.

Smith, G., Sochor, J., and Karlsson, I. C. M. (2019): "Public–Private Innovation: Barriers in the Case of Mobility as a Service in West Sweden", *Public Management Review*, Vol. 21, No. 1, pp. 116-137.

Smith, G., Sochor, J., and Karlsson, I. C. M. (2020): "Intermediary MaaS Integrators: A Case Study on Hopes and Fears", *Transportation Research Part A: Policy and Practice*, Vol. 131, pp. 163-177.

Soto Setzke, D., Kavılı, M. C., and Böhm, M. (2020): "On the Use of Qualitative Comparative Analysis in Information Systems Research - a Critical Review", *European Conference on Information Systems*. Marrakesh.

Stake, R. E. (1994): "Case Studies", Denzin, N. K., and Lincoln, Y. S., *Handbook of Qualitative Research*, SAGE Publications, Thousand Oaks. pp. 236-247.

Stangl, B., Inversini, A., and Schegg, R. (2016): "Hotels' Dependency on Online Intermediaries and Their Chosen Distribution Channel Portfolios: Three Country Insights", *International Journal of Hospitality Management*, Vol. 52, pp. 87-96.

Stare, M. and Rubalcaba, L. B. (2008): "Research on Services: From Exploring the "Residual" to Services Science", Stauss, B., Engelmann, K., Kremer, A., and Luhn, A., *Services Science: Fundamentals, Challenges and Future Developments,* Springer, Berlin. pp. 71-78.

Statista (2017): *Anzahl registrierter Kraftfahrzeuge weltweit in den Jahren 2005 bis 2015*. URL: https://de.statista.com/statistik/daten/studie/244999/umfrage/weltweiter-pkw-und-nutzfahrzeugbestand/#:~:text=Globaler%20Kfz%2DBestand%20h%C3%B6her%20als,global%20registrierten%20Kraftfahrzeuge%20kontinuierlich%20an. (visited on 2021-01-25).

Statista (2018): *Bikesharing hat in Deutschland noch Luft nach oben*. URL: https://de.statista.com/infografik/13573/nutzung-von-bikesharing-in-ausgewaehlten-laendern/#:~:text=2%2C5%20Prozent%20der%20Internetnutzer,%C3%BCber%20Apps%20oder%20Webseiten%20genutzt (visited on 2020-10-08).

Statista (2019): *Wie oft nutzen Sie Car- oder Ride-Sharing?* URL: https://de.statista.com/prognosen/1021762/umfrage-zur-nutzungshaeufigkeit-von-car-oder-ride-sharing-in-deutschland (visited on 2020-10-08).

Statista (2020): *Anzahl der Elektroautos in Deutschland von 2006 bis 2020*. URL: https://de.statista.com/statistik/daten/studie/265995/umfrage/anzahl-der-elektroautos-in-deutschland/ (visited on 2020-10-08).

Statistische Ämter des Bundes und der Länder (2018): *Bevölkerung nach Altersgruppen. Ergebnisse des Zensus 2011*. URL: http://www.statistikportal.de/de/bevoelkerung/ergebnisse-des-zensus-2011/bevoelkerung-nach-altersgruppen (visited on 2020-04-15).

Statistisches Bundesamt (2019): *Automobilindustrie: Deutschlands wichtigster Industriezweig mit Produktionsrückgang um 7,1 % im 2. Halbjahr 2018*. URL: https://www.destatis.de/DE/Presse/Pressemitteilungen/2019/04/PD19_139_811.html#:~:text=Die%20Automobilindustrie%20ist%20Deutschlands%20wichtigster,von%20134%2C9%20Milliarden%20Euro (visited on 2020-10-08).

Steiner, K. and Irnich, S. (2020): "Strategic Planning for Integrated Mobility-on-Demand and Urban Public Bus Networks", *Transportation Science*.

Sthapit, E. and Björk, P. (2019): "Sources of Value Co-Destruction: Uber Customer Perspectives", *Tourism Review,* Vol. 74, No. 4, pp. 780-794.

Stopka, U. (2014): "Identification of User Requirements for Mobile Applications to Support Door-to-Door Mobility in Public Transport", *International Conference on Human-Computer Interaction*. Heraklion.

Storbacka, K. (2019): "Actor Engagement, Value Creation and Market Innovation", *Industrial Marketing Management,* Vol. 80, pp. 4-10.

Storbacka, K., Brodie, R. J., Böhmann, T., Maglio, P. P., and Nenonen, S. (2016): "Actor Engagement as a Microfoundation for Value Co-Creation", *Journal of Business Research,* Vol. 69, No. 8, pp. 3008-3017.

Ströhle, P., Flath, C. M., and Gärttner, J. (2019): "Leveraging Customer Flexibility for Car-Sharing Fleet Optimization", *Transportation Science,* Vol. 53, No. 1, pp. 42-61.

Suchman, M. C. (1995): "Managing Legitimacy: Strategic and Institutional Approaches", *Academy of Management Review,* Vol. 20, No. 3, pp. 571-610.

Takamatsu, M. and Taguchi, A. (2020): "Bus Timetable Design to Ensure Smooth Transfers in Areas with Low-Frequency Public Transportation Services", *Transportation Science,* Vol. 54, No. 5, pp. 1238–1250.

Teddlie, C. and Tashakkori, A. (2009): *Foundations of Mixed Methods Research: Integrating Quantitative and Qualitative Approaches in the Social and Behavioral Sciences*, SAGE Publications, Thousand Oaks.

Teubner, T. and Flath, C. M. (2015): "The Economics of Multi-Hop Ride Sharing. Creating New Mobility Networks through IS", *Business & Information Systems Engineering,* Vol. 57, No. 5, pp. 311-324.

Thompson, N., Kiefer, K., and York, J. G. (2011): "Distinctions Not Dichotomies: Exploring Social, Sustainable, and Environmental Entrepreneurship", Lumpkin, G. T., and Katz, J. A., *Social and Sustainable Entrepreneurship,* Emerald Group, Bingley. pp. 201-229.

Turetken, O., Grefen, P., Gilsing, R., and Adali, O. E. (2019): "Service-Dominant Business Model Design for Digital Innovation in Smart Mobility", *Business & Information Systems Engineering,* Vol. 61, No. 1, pp. 9-29.

Umweltbundesamt (2019): "Veränderungen im Mobilitätsverhalten zur Förderung einer nachhaltigen Mobilität".

Umweltbundesamt (2020a): *Emissionsquellen*. URL: https://www.umweltbundesamt.de/themen/klima-energie/treibhausgas-emissionen/emissionsquellen#energie-stationar (visited on 2020-09-24).

Umweltbundesamt (2020b): *Endenergieverbrauch und Energieeffizienz des Verkehrs*. URL: https://www.umweltbundesamt.de/daten/verkehr/endenergieverbrauch-energieeffizienz-des-verkehrs#endenergieverbrauch-steigt-seit-2010-wieder-an (visited on 2020-10-08).

United Nations Department of Economic and Social Affairs (2015): "World Urbanization Prospects".

van de Walle, S. (2008): "What Services Are Public? What Aspects of Performance Are to Be Ranked? The Case of "Services of General Interest"", *International Public Management Journal,* Vol. 11, No. 3, pp. 256-274.

van Nes, R. and Bovy, P. H. L. (2004): "Multimodal Traveling and Its Impact on Urban Transit Network Design", *Journal of Advanced Transportation,* Vol. 38, No. 3, pp. 225-241.

van Riel, A. C. R., Zhang, J. J., McGinnis, L. P., Nejad, M. G., Bujisic, M., and Phillips, P. A. (2019): "A Framework for Sustainable Service System Configuration: Exploring Value Paradoxes with Examples from the Hospitality Industry", *Journal of Service Management,* Vol. 30, No. 3, pp. 349-368.

Vargo, S. L. and Akaka, M. A. (2009): "Service-Dominant Logic as a Foundation for Service Science: Clarifications", *Service Science,* Vol. 1, No. 1, pp. 32-41.

Vargo, S. L. and Lusch, R. F. (2004): "Evolving to a New Dominant Logic for Marketing", *Journal of Marketing,* Vol. 68, No. 1, pp. 1-17.

Vargo, S. L. and Lusch, R. F. (2017): "Service-Dominant Logic 2025", *International Journal of Research in Marketing,* Vol. 34, No. 1, pp. 46-67.

Vargo, S. L., Maglio, P. P., and Akaka, M. A. (2008): "On Value and Value Co-Creation: A Service Systems and Service Logic Perspective", *European Management Journal,* Vol. 26, No. 3, pp. 145-152.

Venkatesh, V., Brown, S. A., and Bala, H. (2013): "Bridging the Qualitative-Quantitative Divide: Guidelines for Conducting Mixed Methods Research in Information Systems", *MIS Quarterly,* Vol. 37, No. 1, pp. 21-54.

Verband Deutscher Verkehrsunternehmen (2019): "2018 Statistik".

Vickers, I., Lyon, F., Sepulveda, L., and McMullin, C. (2017): "Public Service Innovation and Multiple Institutional Logics: The Case of Hybrid Social Enterprise Providers of Health and Wellbeing", *Research Policy,* Vol. 46, No. 10, pp. 1755-1768.

vom Brocke, J., Simons, A., Niehaves, B., Reimer, K., Plattfaut, R., and Cleven, A. (2009): "Reconstructing the Giant: On the Importance of Rigour in Documenting the Literature Search Process", *European Conference on Information Systems*. Verona.

Vygotsky, L. S. (1978): *Mind in Society: The Development of Higher Psychological Processes,* Harvard University Press, Cambridge.

Wang, X., Agatz, N., and Erera, A. (2018a): "Stable Matching for Dynamic Ride-Sharing Systems", *Transportation Science,* Vol. 52, No. 4, pp. 850-867.

Wang, X., Yang, H., and Zhu, D. (2018b): "Driver-Rider Cost-Sharing Strategies and Equilibria in a Ridesharing Program", *Transportation Science,* Vol. 52, No. 4, pp. 868-881.

Watson, R. T., Boudreau, M.-C., Chen, A. J., and Sepúlveda, H. H. (2011): "Green Projects: An Information Drives Analysis of Four Cases", *Journal of Strategic Information Systems,* Vol. 20, No. 1, pp. 55-62.

Webster, J. and Watson, R. T. (2002): "Analyzing the Past to Prepare for the Future: Writing a Literature Review", *MIS Quarterly,* Vol. 26, No. 2, pp. xiii-xxiii.

Willing, C., Brandt, T., and Neumann, D. (2017a): "Electronic Mobility Market Platforms – a Review of the Current State and Applications of Business Analytics", *Electronic Markets,* Vol. 27, No. 3, pp. 267-282.

Willing, C., Brandt, T., and Neumann, D. (2017b): "Intermodal Mobility", *Business & Information Systems Engineering,* Vol. 59, No. 3, pp. 173-179.

Willing, C., Gust, G., Brandt, T., Schmidt, S., and Neumann, D. (2016): "Enhancing Municipal Analytics Capabilities to Enable Sustainable Urban Transportation", *European Conference on Information Systems*. Istanbul.

Witell, L., Snyder, H., Gustafsson, A., Fombelle, P., and Kristensson, P. (2016): "Defining Service Innovation: A Review and Synthesis", *Journal of Business Research,* Vol. 69, No. 8, pp. 2863-2872.

Wolter, S. (2012): "Smart Mobility - Intelligente Vernetzung der Verkehrsangebote in Großstädten", Proff, H., Schönharting, J., Schramm, D., and Ziegler, J., *Zukünftige Entwicklungen in der Mobilität: Betriebswirtschaftliche und technische Aspekte,* Springer Gabler, Wiesbaden. pp. 527-548.

Wong, R. C. W., Yuen, T. W. Y., Fung, K. W., and Leung, J. M. Y. (2008): "Optimizing Timetable Synchronization for Rail Mass Transit", *Transportation Science,* Vol. 42, No. 1, pp. 57-69.

Wright, S., Nelson, J. D., and Cottrill, C. D. (2020): "MaaS for the Suburban Market: Incorporating Carpooling in the Mix", *Transportation Research Part A: Policy and Practice,* Vol. 131, pp. 206-218.

Yang, B., Ren, S., Legara, E. F., Li, Z., Ong, E. Y. X., Lin, L., and Monterola, C. (2020): "Phase Transition in Taxi Dynamics and Impact of Ridesharing", *Transportation Science,* Vol. 54, No. 1, pp. 250-273.

Yap, M. D., Correia, G., and van Arem, B. (2016): "Preferences of Travellers for Using Automated Vehicles as Last Mile Public Transport of Multimodal Train Trips", *Transportation Research Part A: Policy and Practice,* Vol. 94, pp. 1-16.

Yin, J., Qian, L., and Shen, J. (2019): "From Value Co-Creation to Value Co-Destruction? The Case of Dockless Bike Sharing in China", *Transportation Research Part D: Transport and Environment,* Vol. 71, pp. 169-185.

Yin, R. K. (2018): *Case Study Research and Applications: Design and Methods*, SAGE Publications, Los Angeles.

Zhao, P. and Li, S. (2017): "Bicycle-Metro Integration in a Growing City: The Determinants of Cycling as a Transfer Mode in Metro Station Areas in Beijing", *Transportation Research Part A: Policy and Practice,* Vol. 99, pp. 46-60.

Zimmermann, S., Schulz, T., and Gewald, H. (2020): "Salient Attributes of Mobility Apps: What Does Really Matter for the Citizen?", *Pacific Asia Conference on Information Systems*. Dubai.

Zullo, R. (2008): "Transit Contracting Reexamined: Determinants of Cost Efficiency and Resource Allocation", *Journal of Public Administration Research and Theory,* Vol. 18, No. 3, pp. 495-515.

Appendix

Appendix A. Door-to-Door Mobility Integrators as Keystone Organizations of Smart Ecosystems: Resources and Value Co-Creation – A Literature Review (P1)

Door-to-Door Mobility Integrators as Keystone Organizations of Smart Ecosystems: Resources and Value Co-Creation – A Literature Review

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Abstract. Cities around the world face major mobility-related challenges, such as traffic congestion and air pollution. One primary cause of these challenges is the decision of citizens to use their private car instead of alternative mobility services such as public transport, car-sharing and bike-sharing. Technological progress offers new possibilities to address these challenges by making alternative mobility services easier and more convenient to use. This paper focuses on door-to-door (D2D) mobility integrators, which aim to offer citizens seamless D2D transport by packaging alternative mobility services. To better understand the practical barriers D2D mobility integrators face, this interdisciplinary literature review provides a holistic picture of their operand and operant resources, revealing significant gaps in our understanding of their capability to attract actors to their ecosystem and to manage value co-creation. Based on these gaps, we identify a potential avenue of future research.

Keywords: D2D Mobility Integrators, Literature Review, Operand Resources, Operant Resources, Value Co-Creation.

1 Introduction

Mobility is a basic need of modern society. Currently, most travel is achieved relying on private cars and motorbikes. For example, in Germany motorized private transport constitutes approximately 76% of the modal split of passenger transport [1]. One reason for the prevalence of private motorized transport is the (perceived) weaknesses of alternative mobility services. In the case of public transport, a lack of reliable information about the mobility service and the distance to a station are common perceived weaknesses [2]. Another reason for the prevalence of private motorized transport is that shared services, such as bike-sharing, car-sharing, or ride-sharing have only recently become more comfortable to use due to the increased digital connectivity of the population [3]. As a result, their modal split share has remained relatively low [1].

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However, the impact of such extensive use of motorized private transport is undeniable, especially in cities. Along with an expected rise in the share of people living in cities from 50% in 2015 to 66% by 2050 [4], the number of private cars worldwide is also expected to double by 2035 [5]. The predominant use of the private car causes air and noise pollution, which endangers the health and well-being of the citizens [6], and many cities already face serious traffic congestion and parking problems [7]. An expansion of the road and parking infrastructure is often impossible, prohibitively expensive, or not desirable because natural resources should be sustained. In order to meet these mobility-related challenges, a new mobility paradigm is needed. A promising approach is to combine different alternative mobility services, such as bike-sharing, car-sharing, and public transport, to ease door-to-door (D2D) mobility. This would involve providing up-to-date information about short-term cancellations and delays and adapting trip planning accordingly. If citizens didn't have to gather up-to-date information about multiple alternative mobility service options and undertake a complex comparison/combination and booking process themselves, they may use private cars less [7].

Providing integrated D2D mobility is only possible in an ecosystem of multiple mobility providers, whereby ecosystem is defined as a "system of mostly loosely coupled social and economic (resource-integrating) actors" [8, p. 161]. D2D mobility integrators act as important intermediaries between customers and these mobility providers [9]. Recently, D2D mobility integrators like Moovel (a subsidiary of Daimler AG) and Qixxit (founded by Deutsche Bahn AG) have entered the European mobility market. Their business relies heavily on advanced information technology (IT) and new methods such as business analytics [7, 10]. Analogous to concepts such as 'smart city', 'smart home' [11], or 'smart tourism' [12], the D2D mobility integrators aim to provide a smart service.

Extant research has focused mainly on describing and comparing the quality of different D2D mobility services [7, 10, 13]. Several studies indicate that D2D mobility services provided are often of inferior quality. For example, Albrecht and Ehmke [13] find that D2D mobility integrators struggle to integrate dynamic customer location data and it has been found that only a few mobility providers are willing to join their ecosystem [7, 13]. A valuable theoretical lens through which to investigate the common service provision of multiple actors is service-dominant (S-D) logic [14, 15]. One of the key assumptions of S-D logic is that all actors are engaged in value co-creation – the integration of resources and the exchange of service [15]. To date, however, insufficient attention has been paid to the operand and operant resources actors utilize to provide service in a digital environment [16, 17]. In the case of D2D mobility integrators, there is lack of holistic analysis of their resources and a lack of transparency about resource quality. As a result, it is difficult to appropriately guide the efforts of researchers and practitioners to provide higher quality D2D mobility service. To fill this gap, this study asks the research question:

RQ: What operand and operant resources do D2D mobility integrators utilize to provide D2D mobility services?

To answer this research question, we conduct an interdisciplinary literature review spanning information systems (IS), transportation management, service science and engineering.

The remainder of the paper is structured as follows. After a brief outline of the design of the literature review, we describe our findings. Based on the research gaps identified, we describe an avenue of possible future research. Finally, we discuss the limitations of our study and draw conclusions.

2 Design of the Literature Review

A rigorous and comprehensive literature review, according to Raghuram et al. [18, p. 984] can use "several methodologies such as meta-analysis, descriptive review, and bibliometrics approaches". Each methodology has advantages and disadvantages, giving it a unique "way of seeing [and] a way of not seeing" [19, p. 284]. In this literature review, we follow the guidelines proposed by Webster and Watson [20] in order to include qualitative studies, which are typical for research in emerging fields.

The review process comprises three steps: (1) search leading journals for relevant articles, (2) backward search references in identified articles, and (3) forward search articles referring to the identified articles. In the first step, we searched the Senior Scholars' Basket of Journals of the Association for Information Systems, which contains the leading journals in the IS field. In addition, following the recommendation of Webster and Watson [20], we searched articles presented at the following five important IS conferences – International Conference on Information Systems (ICIS), European Conference on Information Systems (ECIS), Americas Conference on Information Systems (AMCIS), Pacific Asia Conference on Information Systems (PACIS), and Hawaii International Conference on System Sciences (HICSS). Beyond IS, we searched articles contained in the Science Direct and IEEE Xplore databases, which include journal and conference articles published in various fields, such as transportation management, service science, and engineering. Our cut-off date was February 19, 2018. Our keyword search list contained 36 terms in English, including 'intermodal mobility' and 'mobility as a service', as well as the names of well-known D2D mobility integrators (a complete list of keywords can be found in Table 1 of the Appendix).

In addition, we defined the following exclusion and inclusion criteria: (a) we included articles focusing on D2D mobility integrators as part of a digital ecosystem that aims to combine various mobility services. We thus excluded articles dealing with models of transport planning [21, etc.] or physical and organizational transport system integration [e.g., 22]; (b) we excluded articles that focus solely on combining public transport services (e.g., bus, subway, tram) because regional public transport is very often provided by different subsidiaries of the same company [7]. As a result, the parent company faces very different challenges than a D2D mobility integrator cooperating with independent mobility providers; and (c) we excluded theses and books.

Our initial keyword search yielded 4,635 potential articles, which we assessed manually in two rounds. First, we screened the title and, if necessary, the abstract of each article for potential relevance to our research question, selecting 200 articles. Second, we read each remaining article, excluding a further 146 articles. In our backward search, we reviewed the references of the 54 remaining articles, and in our forward search we used the 'cited by' function in Google Scholar (https://scholar.google.com). Ten relevant articles could be identified. Furthermore, the anonymous reviewers have proposed one additional article. In all, we identified 65 relevant articles. Figure 1 illustrates our literature review process.

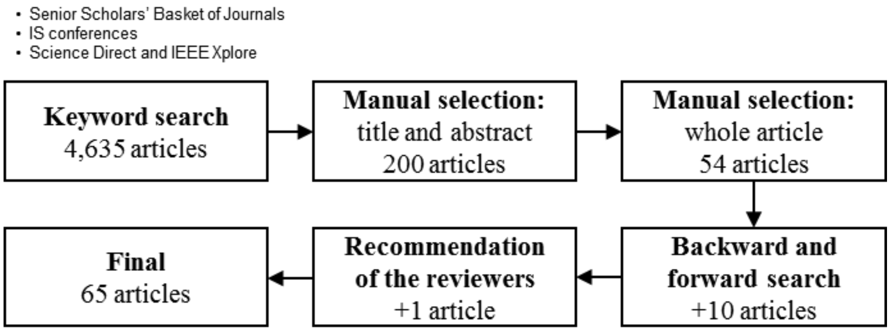

Figure 1. Overview of the literature review process.

We coded the selected articles using an iterative coding approach to ensure internal validity [23]. Our analysis focuses on two main coding categories: operand resources of D2D mobility integrators and operant resources of D2D mobility integrators.

3 Operand and Operant Resources of D2D Mobility Integrators

Operand resources are those "resources on which an operation or act is performed" (e.g., animal life, land, minerals), whereas operant resources "are employed to act on operand resources" (capabilities, competences, knowledge, organizational processes, skills, etc.) [14, p. 2, 24]. In order to provide a D2D mobility service, D2D mobility integrators rely on both types of resources. The classification as operand or operant resource depends on the evaluator's perspective [25]. Adopting a D2D mobility integrator perspective at the company level, an algorithm for determining the best combination of mobility services is an operand resource. But if the perspective of the algorithm itself is taken, it is an operant resource that adds or does not add a single mobility service to a D2D mobility service. This research adopts the first perspective. The next two sections present the resources of D2D mobility integrators discussed in scientific literature. The identified resources are italicized.

3.1 Operand Resources

Fourteen articles provide a kind of *blueprint* and colloquially describe the basic idea of the new D2D mobility integrator role [26-28]. Frequently, one or more characteristics of the provided D2D mobility service are also discussed in detail. These studies often originated from scientific research projects, as, for instance, in the case of Boero et al. [29], Gogos and Letellier [30], and Motta et al. [31]. Possibly for this reason, the contents of the blueprints differ widely in terms of geographic focus, ranging from a single city [31], to a larger region like Piedmont [32], up to the European Union [29, 30]. Moreover, the authors of the blueprints also adopt differing perspectives in assessing the added value of D2D mobility integrators and their D2D mobility service. Only a few authors [e.g., 30] take a mobility provider perspective, whereas a majority [e.g., 29, 33] take the perspective of citizens and city administrations. Perhaps as a result of these differences, the blueprints take a varying number of mobility services and mobility providers into account [see, e.g., 7, 27, 34]. Nevertheless, they often strive to offer D2D mobility services with similar characteristics, including providing real-time updates and booking and paying for trips through the D2D mobility integrator [35-38].

A further operand resource are *representations* of the *business model* of D2D mobility integrators. Beutel et al. [39] examine how existing business model frameworks are subject of change in the case of D2D mobility integrators and propose a new business model framework for D2D mobility integrators. A similar approach is chosen by Willing et al. [10], who adapt a business model framework to classify multiple D2D mobility integrators. In particular, they highlight the importance of business analytics. Schulz et al. [40] introduce a new model for the roles of D2D mobility integrators based on the roles of an intermediary in the electronic commerce era. Table 2 provides an overview of the operand resources of D2D mobility integrators.

Table 2. Overview of operand resources of D2D mobility integrators.

Operand resource	**Authors**
Blueprint	[7]; [26]; [27]; [28]; [29]; [30]; [31]; [32]; [33]; [34]; [35]; [36]; [37]; [38]
Representation of the business model	[10]; [39]; [40]
Information system application	[41]; [42]; [43]
National framework architecture	[44]; [45]
Information system architecture	[46]; [47]; [48]; [49]; [50]; [51]; [52]; [53]; [54]; [55]; [56]; [57]; [58]; [59]; [60]; [61]; [62]; [63]
Interface	[64]; [65]
Model and algorithm	[66]; [67]; [68]; [69]; [70]; [71]; [72]; [73]; [74]
Compensation engine	[75]
Recommendation system	[76]; [77]; [78]; [79]

Other articles deal with operand resources which are technical in nature, such as the *information system application*. Based on the trip phases, Digmayer et al. [41] derive the activities of users and the support they require, drawing implications for app design, such as implementing a feedback feature. Stein et al. [42] designed an app, especially for the elderly. Based on their experience in the WISETRIP project, Spitadakis and

Fostieri [43] also make recommendations for improving the design of an app or a web interface.

A related operand resource is ARKTRANS, the *national framework architecture* for mobility information systems in Norway, which encompasses all transport modes and supports D2D mobility [44, 45].

Eighteen articles describe the *information system architecture* of a specific D2D mobility integrator. In line with our previous findings, most of the authors – with exception of Dotoli et al. [46], and Zoghlami et al. [47] – explain the architecture created within the time restraints of their scientific research projects [e.g., 48-51]. It should be noted that several articles focus on the architecture of the Mobility Broker project [52-54], and two articles each focus on the architecture of the IMA [55, 56], Instant Mobility [57, 58], and SMAll [59, 60] project. The authors apply varying architecture styles. For example, Hilgert et al. [61] use the concept of microservices, Motta et al. [62] adopt a service-oriented architecture – event driven architecture (SOA-EDA), whereas Evangelatos et al. [63] draw on the Super Travel API Architecture.

Natvig and Vennesland [64] emphasize the advantage of open *interfaces* for the provision of a D2D mobility service. They also describe the interface definition process and a pilot implementation. Kluth et al. [65] develop an interface that facilitates connecting the rental systems of car-sharing and bike-sharing providers with the information system of D2D mobility integrators. The new interface enables information exchange (e.g., vehicle data, price information) and the execution of bookings via D2D mobility integrators.

A *model* to map the transport system (train stations, bus lines, etc.) and an *algorithm* to identify the best combination of mobility services are further operand resources of D2D mobility integrators. The algorithms can determine the shortest [e.g., 66-69], the fastest [70, 71, etc.], the cheapest [71], the most energy-efficient [72], or the least complex [71] D2D trip. Some algorithms allow the selection from several criteria, while others are restricted to one criterion. In addition, the algorithms vary in terms of whether they work with real-time data [70, 72, etc.] or not [e.g., 71]. Another difference is the scope of mobility services taken into account. For example, Fahnenschreiber et al. [73] and Ma [74] focus on integrating ride-sharing services. Given long running times, the algorithms [e.g., 67, 68, 71] in part prove the basic feasibility of the optimization idea than its practical usability.

Rizzi et al. [75] provide a detailed description of one specific part of the information system, the so-called *compensation engine*, which is responsible for monitoring and re-scheduling the selected combination of mobility services. This technical component enables customers to switch to alternative mobility services in case of a delay or cancellation of a previously chosen mobility service.

While the articles in the last two sections deal with operand resources that are necessary to determine the optimal combination of mobility services based on pre-defined customer criteria, the following articles center on *recommendation systems*, which are deployed to measure and to learn customers' preferences. The framework developed by Samsel et al. [76] helps rate the possible combinations depending on the previously revealed preferences (e.g., tendency to choose the shortest trip), the context (weather, etc.), and the selection made by the crowd. A similar approach focusing on learning customers' preferences is described by Arentze [77], and Zhang and Arentze [78], whose customer criteria include, among others, travel time, monetary costs, environmental impact, and changeover safety. The authors also analyze mobility service preferences (bus, train, etc.). Poxrucker et al. [79] described a simulation tool that can be used to learn from customers' aggregated recommendations and selection. Such an approach is necessary to prevent a bus from overcrowding due to over-recommendation.

3.2 Operant Resources

In order to enable value co-creation, D2D mobility integrators also need different operant resources, such as capabilities, competences and organizational processes, to act on operand resources. Spickermann et al. [80] provide a strategic agenda that highlights the importance of pursuing a *transition strategy*. In particular, they emphasize the need for aspiring D2D mobility integrators to use advanced IT and change their business model. The necessity of a transition strategy is further demonstrated by the work of Sarasini et al. [81] suggesting a research agenda to examine the causes of change and inertia of business models.

Three articles deal with the *implementation process* of a D2D mobility concept. Smith et al. [82] analyze the procurement process of a Swedish public transport organization, which enables a successful bidder to act as a regional D2D mobility integrator. Their results identify seven topics, such as the allocation of responsibilities and technical integration that potential bidders consider important in creating an ecosystem. Khanna and Venters [83, 84] examine the implementation process in the case of the BeMobility project in Berlin. They focus on the D2D mobility integrator's designing an information system for integrating electric car-sharing into public transport infrastructure. Table 3 summarizes the identified operant resources of D2D mobility integrators.

Table 3. Overview of operant resources of D2D mobility integrators.

Operant resource	Authors
Transition strategy	[80]; [81]
Implementation process	[82]; [83]; [84]
Capability to ensure security and privacy	[85]; [86]; [87]; [88]

A further important operant resource of D2D mobility integrators is their *capability* to ensure the *security and privacy* of ecosystem actors. Referring to the SMAll project, Callegati et al. [85] describe the most relevant weaknesses in terms of data reliability, integrity, and authenticity and propose mitigation approaches. For instance, they argue for the implementation of a customer rating system in order to evaluate data sources and enhance data trustworthiness. Further studies deal with insider threats as one of the most prominent security and privacy concerns [86, 87], providing a classification of insider threats. For example, a D2D mobility integrator must be aware of potentially fraudulent data manipulation on behalf of mobility providers. To mitigate insider threats, a networking architecture that based on gossip protocols is introduced. The high relevance of security and privacy is also demonstrated through customer evaluation of the information system of the Mobility Broker project [88].

4 Central Issues for Future Research

This section presents core issues for future research into the operand and operant resources of D2D mobility integrators. We expect that research on these issues will contribute to a deeper understanding of the role of D2D mobility integrators and enable recommendations to put value co-creation into practice.

Our literature review shows that most studies are concerned with the **operand resources** of D2D mobility integrators, such as their information system architecture [e.g., 46, 47], and algorithms for determining the best combination of different mobility services [66, 70, 72, etc.]. We note that D2D mobility integrators should generally be able to access the required operand resources, particularly those of a technical nature. However, many operand resources have only been developed for/used by D2D mobility integrators in the context of scientific research projects. Their real-world practical usefulness remains to be seen. For example, the running times of some of the algorithms [e.g., 67, 68, 71] make them impractical. It is also important to examine how technological progress affects individual technical resources. Currently, the extent to which state-of-the-art IT is taken into account varies greatly. For instance, whereas big data and business analytics are used in the case of the recommendation systems of Poxrucker et al. [79] and Samsel et al. [76], its impact on information system architecture remains unclear [50, 52, etc.].

In contrast, **operant resources** have been largely neglected by scientific research, or, as in the case of pursuing a transition strategy, their importance has only been emphasized in terms of a research agenda [81] or practical implications [80]. In particular, there are no broad insights into the *capability* of D2D mobility integrators *to manage value co-creation* (i.e., the integration of resources and the exchange of service [15]), in the ecosystem. Only three articles [82-84] shed light on the development phase of the ecosystem. The sparsity of research into operant resource needs points to several research gaps, for example what resources are needed in various ecosystem maturation phases, what models of value co-creation are possible in each phase, and how business model transitions can be best managed. Analogously, the phases of the value co-creation process between a D2D mobility integrator and an ecosystem actor (e.g., customer, mobility provider) should also be analyzed.

Since only a few mobility providers have joined an ecosystem of D2D mobility integrators to date [7, 13], future research should provide insights into their *capability to attract actors* – a sub-capability of value co-creation management. In order to explain non-membership, we propose determining the (perceived) value for the actors. As shown in our findings, extant literature predominantly reflects the view of researchers and practitioners adopting the role of D2D mobility integrators [e.g., 30, 37], or working on the development of a single operand resource [56, 65, etc.]. The customer or mobility provider perspective was only seldom considered [42, 43, 88]. However, according to Akaka and Chandler [89, p. 251] (social) roles are important resources for value co-creation "because they guide expectations for the exchange of service". To date, little scholarship is available into how actors evaluate the role of D2D mobility integrators and its related set of practices. One exception is Beutel et al. [88], who find that providing price bundles is often evaluated negatively by customers due to data security and privacy concerns. Overall, we believe that identifying the divergent expectations of actors about the role of D2D mobility integrators can help to better understand what motivates their decision to join or not join a D2D mobility ecosystem.

The capability of D2D mobility integrators to attract actors to their ecosystem depends not only on whether they fulfill the expectations of potential customers and mobility providers. As seen through the lens of S-D logic [14, 15], which assumes that all actors are engaged in value co-creation, every actor is already embedded in multiple ecosystems coordinated by a set of rules, norms and beliefs, known as institutions, and higher-order collections of these institutions, known as institutional arrangements [15]. For instance, German mobility providers that provide bus and tram transport are often integrated into the ecosystem of a municipal utility which is acting as parent company [7]. Hence, the decision of potential customers and mobility providers on membership in the D2D mobility integrator ecosystem is influenced by the actors of their existing ecosystems.

This literature review indicates that no research has been done on this topic. One avenue of possible future research is how the existing institutional arrangements of potential customers and mobility providers influence their decision whether or not to join the ecosystem of D2D mobility integrators. This might be viewed through the theoretical lens of legitimacy [90]. A potential study could consider the interests and authority of all actors of established ecosystems, such as parent companies, city administrations and industry associations in terms of preventing or mandating collaboration with D2D mobility integrators. Relying on power-based theory [91], this approach would help D2D mobility integrators better understand the relevant actors and their interests, and adapt their role and the institutional arrangements established in the ecosystem to increase value co-creation.

In summary, we argue for a two-step analysis to enhance our knowledge about the capability of D2D mobility integrators to attract actors to their ecosystem – the evaluation of the fulfillment of the role expectations by D2D mobility integrators and the actors' embeddedness in existing ecosystems. We assume that this approach can also be used to investigate the capability of D2D mobility integrators to manage value co-creation in the later phases of the ecosystem and better understand why mobility providers, for instance, provide real-time timetable data but are not able or willing to participate in a common ticketing.

5 Conclusion

In this paper, we conduct a literature review on the operand and operant resources required by D2D mobility integrators. Based on our findings, we propose several avenues of future research, including analyzing the operand resources used by D2D mobility integrators outside the project environment, D2D mobility integrators' capability to manage value co-creation in the different phases of the ecosystem, and the sub-capability of D2D mobility integrators to attract actors to their ecosystem in the first phase.

By reviewing scientific literature and deriving avenues of future research, our study contributes to IS and S-D logic literature in several ways. First, it provides a holistic view on research on the operand and operant resources of D2D mobility integrators. Our study integrates previously unrelated studies focusing on a single resource. This overview of the current state of research and, to a degree, practice, enables us to identify research gaps and practical challenges, which serve as the basis for developing avenues of future research. Practitioners can benefit from our work by understanding the resources necessary to put value co-creation into practice.

Our study is subject to some limitations. First, despite our backward and forward searches, our selection of outlets and keywords may have excluded some relevant scholarship. Second, the level of granularity and aggregation we choose in terms of analyzing resources may have excluded some insights into additional resources.

Appendix

Table 1. Keywords.

Allryder	GoEuro	Mobility Map	Multimodal mobility
Citymapper	Integrated mobility	Mobility marketplace	Multimodal travel
Connected mobility	Intermodal mobility	Mobility markets	Networked mobility
D2D mobility	Intermodal Mobility Assistance for Megacities (IMA)	Mobility network	Qixxit
Door 2 Door mobility	Intermodal travel	Mobility on demand	Rome2rio
Door2door	MeMobility	Mobility platform	RouteRANK
Door-to-door mobility	Mobility as a service	Modular mobility	Smart mobility
FromAtoB	Mobility Broker Project	Moovel	Transit App
Future mobility	Mobility ecosystem	Moovit	Waymate

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References

1. Bundesministerium für Verkehr und digitale Infrastruktur: Verkehr in Zahlen 2016/2017 (2016).
2. Beirão, G., Cabral, J.A.S.: Understanding Attitudes Towards Public Transport and Private Car: A Qualitative Study. Transport Policy 14, 478-489 (2007).
3. Puschmann, T., Alt, R.: Sharing Economy. Business & Information Systems Engineering 58, 93-99 (2016).
4. United Nations Department of Economic and Social Affairs: World Urbanization Prospects (2015).
5. International Energy Agency: World Energy Outlook 2012 (2012).
6. Barth, M., Boriboonsomsin, K.: Real-World Carbon Dioxide Impacts of Traffic Congestion. Transportation Research Record: Journal of the Transportation Research Board, 163-171 (2008).
7. Willing, C., Brandt, T., Neumann, D.: Intermodal Mobility. Business & Information Systems Engineering 59, 173-179 (2017).
8. Lusch, R.F., Nambisan, S.: Service Innovation: A Service-Dominant Logic Perspective. MIS Quarterly 39, 155-175 (2015).
9. Agarwal, N., Soh, C., Yeow, A.: Value Co-Creation in Service Ecosystems: A Member Perspective. In: International Conference on Information Systems (2016).
10. Willing, C., Brandt, T., Neumann, D.: Electronic Mobility Market Platforms – A Review of the Current State and Applications of Business Analytics. Electronic Markets 27, 267-282 (2017).
11. Rocznik, D., Goffart, K., Wiesche, M., Krcmar, H.: Towards Identifying User-Centered Requirements for Smart In-House Mobility Services. KI-Künstliche Intelligenz 31, 249-256 (2017).
12. Gretzel, U., Sigala, M., Xiang, Z., Koo, C.: Smart Tourism: Foundations and Developments. Electronic Markets 25, 179-188 (2015).
13. Albrecht, L., Ehmke, J.F.: Innovative Services in der Mobilitätsbranche: Eine Marktanalyse multimodaler Mobilitätsmanager. In: Multikonferenz Wirtschaftsinformatik (2016).
14. Vargo, S.L., Lusch, R.F.: Evolving to a New Dominant Logic for Marketing. Journal of Marketing 68, 1-17 (2004).
15. Vargo, S.L., Lusch, R.F.: Service-Dominant Logic 2025. International Journal of Research in Marketing 34, 46-67 (2017).
16. Lenka, S., Parida, V., Wincent, J.: Digitalization Capabilities as Enablers of Value Co-Creation in Servitizing Firms. Psychology & Marketing 34, 92-100 (2017).
17. Brust, L., Breidbach, C.F., Antons, D., Salge, T.O.: Service-Dominant Logic and Information Systems Research: A Review and Analysis Using Topic Modeling. In: International Conference on Information Systems (2017).
18. Raghuram, S., Tuertscher, P., Garud, R.: Research Note - Mapping the Field of Virtual Work: A Cocitation Analysis. Information Systems Research 21, 983-999 (2010).
19. Poggi, G.: A Main Theme of Contemporary Sociological Analysis: Its Achievements and Limitations. British Journal of Sociology 16, 283-294 (1965).
20. Webster, J., Watson, R.T.: Analyzing the Past to Prepare for the Future: Writing a Literature Review. MIS Quarterly 26, xiii-xxiii (2002).
21. Hoogendoorn-Lanser, S., van Nes, R., Hoogendoorn, S.P., Bovy, P.: Home-Activity Approach to Multimodal Travel Choice Modeling. Transportation Research Record: Journal of the Transportation Research Board, 180-187 (2006).

22. Li, L., Loo, B.P.Y.: Towards People-centered Integrated Transport: A Case Study of Shanghai Hongqiao Comprehensive Transport Hub. Cities 58, 50-58 (2016).
23. Strauss, A.L., Corbin, J.M.: Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory. SAGE Publications, Thousand Oaks (1998).
24. Madhavaram, S.R., Hunt, S.D.: The Service-Dominant Logic and a Hierarchy of Operant Resources: Developing Masterful Operant Resources and Implications for Marketing Strategy. Journal of the Academy of Marketing Science 36, 67-82 (2008).
25. Spohrer, J., Vargo, S.L., Caswell, N., Maglio, P.P.: The Service System is the Basic Abstraction of Service Science. In: Hawaii International Conference on System Sciences (2008).
26. Giesecke, R., Surakka, T., Hakonen, M.: Conceptualising Mobility as a Service: A User Centric View on Key Issues of Mobility Services. In: Conference on Ecological Vehicles and Renewable Energies (2016).
27. Kamargianni, M., Li, W., Matyas, M., Schäfer, A.: A Critical Review of New Mobility Services for Urban Transport. Transportation Research Procedia 14, 3294-3303 (2016).
28. Kamargianni, M., Matyas, M.: The Business Ecosystem of Mobility-as-a-Service. In: Transportation Research Board (2017).
29. Boero, M., Garré, M., Fernandez, J., Persi, S., Quesada, D., Jakob, M.: MyWay Personal Mobility: From Journey Planners to Mobility Resource Management. Transportation Research Procedia 14, 1154-1163 (2016).
30. Gogos, S., Letellier, X.: IT2Rail: Information Technologies for Shift to Rail. Transportation Research Procedia 14, 3218-3227 (2016).
31. Motta, G., Sacco, D., Belloni, A., You, L.: A System for Green Personal Integrated Mobility: A Research in Progress. In: International Conference on Service Operations and Logistics, and Informatics (2013).
32. Arneodo, F., Castelli, R., Botta, D.: Towards a “Smart Region” Paradigm: Beyond Smart Cities Borders: Piedmont Region Experience. In: International Conference of Electrical and Electronic Technologies for Automotive (2017).
33. Motta, G., Ferrara, A., Sacco, D., You, L., Cugola, G.: Integrated Mobility: A Research in Progress. Journal of Software Engineering and Applications 6, 97-101 (2013).
34. Jittrapirom, P., Caiati, V., Feneri, A.-M., Ebrahimigharehbaghi, S., Alonso-González, M.J., Narayan, J.: Mobility as a Service: A Critical Review of Definitions, Assessments of Schemes, and Key Challenges. Urban Planning 2, 13-25 (2017).
35. Deniaud, I., Quiguer, S., Breuil, D., Le Maguet, P., Lecourt, J., Pourcel, C., Ruault, J.-R., Somat, A.: Interoperability Dimensions for Multimodal Mobility Management. In: IFAC Symposium on Information Control Problems in Manufacturing (2012).
36. Melis, A., Mirri, S., Prandi, C., Prandini, M., Salomoni, P., Callegati, F.: Integrating Personalized and Accessible Itineraries in MaaS Ecosystems Through Microservices. Mobile Networks and Applications 23, 167-176 (2017).
37. Beutel, M.C., Krempels, K.-H.: Encompassing Payment for Heterogeneous Travelling: Design Implications for a Virtual Currency based Payment Mechanism for Intermodal Public Transport. In: International Conference on Smart Grids and Green IT Systems (2014).
38. Ambrosino, G., Nelson, J.D., Boero, M., Pettinelli, I.: Enabling Intermodal Urban Transport through Complementary Services: From Flexible Mobility Services to the Shared Use Mobility Agency: Workshop 4. Developing Inter-Modal Transport Systems. Research in Transportation Economics 59, 179-184 (2016).
39. Beutel, M.C., Samsel, C., Mensing, M., Krempels, K.-H.: Business Model Framework to Provide Heterogeneous Mobility Services on Virtual Markets. In: International Conference on e-Business (2014).

40. Schulz, T., Rockmann, R., Weeger, A.: Service Composition in Networks – Towards a Typology of Intermediaries. In: Americas Conference on Information Systems (2016).
41. Digmayer, C., Vogelsang, S., Jakobs, E.-M.: Designing Mobility Apps to Support Intermodal Travel Chains. In: International Conference on the Design of Communication (2015).
42. Stein, M., Meurer, J., Boden, A., Wulf, V.: Mobility in Later Life - Appropriation of an Integrated Transportation Platform. In: Conference on Human Factors in Computing Systems (2017).
43. Spitadakis, V., Fostieri, M.: WISETRIP - International Multimodal Journey Planning and Delivery of Personalized Trip Information. Procedia - Social and Behavioral Sciences 48, 1294-1303 (2012).
44. Natvig, M.K., Westerheim, H.: National Multimodal Travel Information – A Strategy based on Stakeholder Involvement and Intelligent Transportation System Architecture. IET Intelligent Transport Systems 1, 102-109 (2007).
45. Natvig, M.K., Westerheim, H.: Refinement and Evaluation of the ARKTRANS Framework Through Use in Travel Information Services. In: World Congress on Intelligent Transport Systems and ITS America's 2008 Annual Meeting (2008).
46. Dotoli, M., Zgaya, H., Russo, C., Hammadi, S.: A Multi-Agent Advanced Traveler Information System for Optimal Trip Planning in a Co-Modal Framework. IEEE Transactions on Intelligent Transportation Systems 18, 2397-2412 (2017).
47. Zoghlami, N., Jeribi, K., Merlo, C., Zgaya, H., Hammadi, S.: A Multi-Agent Architecture for a Co-Modal Transport System. Journal of Modern Engineering Research 4, 60-78 (2014).
48. Fiorentino, A., De Gioia, C., Gaido, M., Conti, G., Magliocchetti, D., De Amicis, R., Kipp, W.: Mobile Integration Platform Concept: The Naples Pilot Test Site. Procedia - Social and Behavioral Sciences 48, 1855-1864 (2012).
49. Eryilmaz, E., Kagerbauer, M., Schuster, T., Wolf, O.: Collaborative Management of Intermodal Mobility. In: Working Conference on Virtual Enterprises (2014).
50. Solar, A., Marqués, A.: ENHANCED WISETRIP: Wide Scale Multimodal and Intelligent Journey Planning. Procedia-Social and Behavioral Sciences 48, 2940-2949 (2012).
51. Zografos, K., Madas, M.: Optimizing Intermodal Trip Planning Decisions in Interurban Networks. Transportation Research Record: Journal of the Transportation Research Board 61-69 (2003).
52. Beutel, M.C., Gökay, S., Kluth, W., Krempels, K.-H., Samsel, C., Terwelp, C.: Product Oriented Integration of Heterogeneous Mobility Services. In: International Conference on Intelligent Transportation Systems (2014).
53. Beutel, M.C., Gökay, S., Kluth, W., Krempels, K.-H., Ohler, F., Samsel, C., Terwelp, C., Wiederhold, M.: Information Integration for Advanced Travel Information Systems. Journal of Traffic and Transportation Engineering 4, 177-185 (2016).
54. Beutel, M.C., Gökay, S., Kluth, W., Krempels, K.-H., Samsel, C., Terwelp, C., Wiederhold, M.: Heterogeneous Travel Information Exchange. In: International Conference on Mobility in IoT (2016).
55. Masuch, N., Lützenberger, M., Keiser, J.: An Open Extensible Platform for Intermodal Mobility Assistance. Procedia Computer Science 19, 396-403 (2013).
56. Keiser, J., Masuch, N., Lützenberger, M., Grunewald, D., Kern, M., Trollmann, F., Acar, E., Salma, Ç.A., Dang, X.-T., Kuster, C.: IMA - An Adaptable and Dynamic Service Platform for Intermodal Mobility Assistance. In: International Conference on Intelligent Transportation Systems (2014).

57. Zargayouna, M., Zeddini, B., Scemama, G., Othman, A.: Simulating the Impact of Future Internet on Multimodal Mobility. In: International Conference on Computer Systems and Applications (2014).
58. Zargayouna, M., Scemama, G., Zeddini, B., Kompfner, P., Gatellier, P., Constant, P., Beckman, D.: Future Internet for a Personal Travel Companion Service. In: ITS World Congress (2012).
59. Callegati, F., Delnevo, G., Melis, A., Mirri, S., Prandini, M., Salomoni, P.: I Want to Ride My Bicycle: A Microservice-Based Use Case for a MaaS Architecture. In: IEEE Symposium on Computers and Communications (2017).
60. Callegati, F., Gabbrielli, M., Giallorenzo, S., Melis, A., Prandini, M.: Smart Mobility for All: A Global Federated Market for Mobility-as-a-Service Operators. In: International Conference on Intelligent Transportation (2017).
61. Hilgert, T., Kagerbauer, M., Schuster, T., Becker, C.: Optimization of Individual Travel Behavior through Customized Mobility Services and their Effects on Travel Demand and Transportation Systems. Transportation Research Procedia 19, 58-69 (2016).
62. Motta, G., Sacco, D., Ma, T., You, L., Liu, K.: Personal Mobility Service System in Urban Areas: The IRMA Project. In: IEEE Symposium on Service-Oriented System Engineering (2015).
63. Evangelatos, S., Kalampoukis, Z., Fergadioti, I., Christofi, S., Karakostas, B., Zorgios, Y.: Service Availability Analysis of a Multimodal Travel Planner Using Stochastic Automata. In: IEEE Symposium on Computers and Communications (2017).
64. Natvig, M.K., Vennesland, A.: Flexible Organisation of Multimodal Travel Information Services. IET Intelligent Transport Systems 4, 401-412 (2010).
65. Kluth, W., Beutel, M.C., Gökay, S., Krempels, K.-H., Samsel, C., Terwelp, C.: IXSI - Interface for X-Sharing Information. In: International Conference on Web Information Systems and Technologies (2015).
66. Delling, D., Pajor, T., Wagner, D.: Accelerating Multi-Modal Route Planning by Access-Nodes. In: European Symposium on Algorithms (2009).
67. Zhang, J., Liao, F., Arentze, T., Timmermans, H.: A Multimodal Transport Network Model for Advanced Traveler Information Systems. Procedia - Social and Behavioral Sciences 20, 313-322 (2011).
68. Zhang, J., Liao, F., Arentze, T., Timmermans, H.: A Multimodal Transport Network Model for Advanced Traveler Information Systems. Procedia Computer Science 5, 912-919 (2011).
69. Hrncir, J., Jakob, M.: Generalised Time-Dependent Graphs for Fully Multimodal Journey Planning. In: International IEEE Conference on Intelligent Transportation Systems (2013).
70. Rouhieh, B., Alecsandru, C.: Optimizing Route Choice in Multimodal Transportation Networks. Canadian Journal of Civil Engineering 41, 800-810 (2014).
71. Yu, H., Lu, F.: A Multi-Modal Route Planning Approach With an Improved Genetic Algorithm. In: International Conference on Theory, Data Handling and Modelling in GeoSpatial Information Science (2010).
72. Prandtstetter, M., Straub, M., Puchinger, J.: On the Way to a Multi-Modal Energy-Efficient Route. In: Conference of the IEEE Industrial Electronics Society (2013).
73. Fahnenschreiber, S., Gündling, F., Keyhani, M.H., Schnee, M.: A Multi-Modal Routing Approach Combining Dynamic Ride-Sharing and Public Transport. Transportation Research Procedia 13, 176-183 (2016).
74. Ma, T.-Y.: On-Demand Dynamic Bi-/Multi-Modal Ride-Sharing Using Optimal Passenger-Vehicle Assignments. In: IEEE International Conference on Environment and Electrical Engineering and IEEE Industrial and Commercial Power Systems Europe (2017).

75. Rizzi, F., Motta, G., Sacco, D.: A System for Green Personal Integrated Mobility: Compensation Engine. International Journal of Computer Applications 105, 5-11 (2014).
76. Samsel, C., Garbereder, G., Krempels, K.-H.: Personalized, Context-aware Intermodal Travel Information. In: International Conference on Web Information Systems and Technologies (2016).
77. Arentze, T.A.: Adaptive Personalized Travel Information Systems: A Bayesian Method to Learn Users' Personal Preferences in Multimodal Transport Networks. IEEE Transactions on Intelligent Transportation Systems 14, 1957-1966 (2013).
78. Zhang, J., Arentze, T.A.: Personalized Multi-Modal Route Planning: A Preference-Measurement and Learning-Based Approach. In: International Conference on Mobile and Ubiquitous Systems: Computing, Networking and Services (2014).
79. Poxrucker, A., Bahle, G., Lukowicz, P.: Simulating Adaptive, Personalized, Multi-Modal Mobility in Smart Cities. In: EAI International Summit Smart City 360° (2016).
80. Spickermann, A., Grienitz, V., von der Gracht, H.A.: Heading Towards a Multimodal City of the Future?: Multi-stakeholder Scenarios for Urban Mobility. Technological Forecasting and Social Change 89, 201-221 (2014).
81. Sarasini, S., Linder, M., Langeland, O., Julsrud, T.-E.: Integrating a Business Model Perspective into Sustainability Transitions: A Research Agenda based on Servitised Mobility. In: International Sustainability Transitions Conference (2016).
82. Smith, G., Sochor, J., Karlsson, M.: Procuring Mobility as a Service: Exploring Dialogues with Potential Bidders in West Sweden. In: ITS World Congress (2017).
83. Khanna, A., Venters, W.: The Role of Intermediaries in Designing Information Infrastructures in Strategic Niches: The Case of a Sustainable Mobility Infrastructure Experiment in Berlin. In: European Conference on Information Systems (2013).
84. Khanna, A., Venters, W.: Exploring the Rhythms of Information Infrastructure Coordination for Smart Cities: The Case of Building a Mobility Infrastructure in Berlin. In: European Conference on Information Systems (2014).
85. Callegati, F., Giallorenzo, S., Melis, A., Prandini, M.: Data Security Issues in MaaS-Enabling Platforms. In: International Forum on Research and Technologies for Society and Industry Leveraging a better tomorrow (2016).
86. Callegati, F., Giallorenzo, S., Melis, A., Prandini, M.: Insider Threats in Emerging Mobility-as-a-Service Scenarios. In: Hawaii International Conference on System Sciences (2017).
87. Callegati, F., Giallorenzo, S., Melis, A., Prandini, M.: Cloud-of-Things meets Mobility-as-a-Service: An Insider Threat Perspective. Computers & Security 74, 277-295 (2018).
88. Beutel, M.C., Zaunbrecher, B.S., Himmel, S., Krempels, K.-H., Ziefle, M.: Evaluation of an Integrated Intermodal Travel Service. In: International Conference on Smart Cities and Green ICT Systems (2016).
89. Akaka, M.A., Chandler, J.D.: Roles as Resources: A Social Roles Perspective of Change in Value Networks. Marketing Theory 11, 243-260 (2011).
90. Dacin, M.T., Oliver, C., Roy, J.P.: The Legitimacy of Strategic Alliances: An Institutional Perspective. Strategic Management Journal 28, 169-187 (2007).
91. Rodríguez, C., Langley, A., Béland, F., Denis, J.-L.: Governance, Power, and Mandated Collaboration in an Interorganizational Network. Administration & Society 39, 150-193 (2007).

Appendix B. Smart Mobility – An Analysis of Potential Customers' Preference Structures (P2)

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RESEARCH PAPER

Smart mobility – an analysis of potential customers' preference structures

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Abstract
Cities around the world face major challenges caused by the extensive use of private cars. To counteract these problems, a new paradigm is necessary which promotes alternative mobility services. 'Smart mobility' refers to a new mobility behaviour that makes use of innovative technical solutions, such as the IT-supported combination of different alternative mobility services during a trip from an origin to a destination. Unfortunately, relatively few customers use apps that provide recommendations for smart mobility and there is limited knowledge about the desires, priorities and needs of potential customers. To fill this gap, we use conjoint analysis to explore differences in smart mobility app preferences across groups of people with varying mobility behaviour. Our study also considers the effect of age and place of residence on preference structures. Our results show, for example, that only car drivers do not consider the price of the smart mobility app to be particularly important for their selection decision.

Keywords Conjoint analysis · Mobility as a service (MaaS) · Monetization · Preference structure · Smart mobility

JEL classification C13 · M310 · R410

Introduction

Big cities and towns around the world are challenged to change the mobility behaviour of their citizens and of commuters from rural areas away from predominantly private car use and toward using alternative mobility services such as public transport or bike- and car-sharing. Such a new mobility behaviour paradigm would help cities address important challenges, including traffic congestion and insufficient parking, as well as air and noise pollution (Benevolo et al. 2016; Schreieck et al. 2018b; Willing et al. 2017a, 2017b). Given that the percentage of the worldwide population living in urban areas is expected to increase from 50% in 2015 to 66% by 2050 (United Nations Department of Economic and Social Affairs 2015), these challenges are pressing.

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One opportunity to support behavioural changes is enabled through ongoing technical progress and the proliferation of information technology (IT). In the recent past, particularly the smartphone has fundamentally changed the provision of services, including mobility services. The use of smartphone apps makes alternative mobility services such as car-sharing (Firnkorn and Müller 2011; Hildebrandt et al. 2015), bike-sharing (Shaheen et al. 2010), or ride-sharing (Rayle et al. 2014; Teubner and Flath 2015) easier and more comfortable to use. As a result, the importance of private car ownership and the emotional attachment to the car in particular among 18–24-year-olds is declining (Bratzel 2018; Circella et al. 2017; Kuhnimhof et al. 2012; Umweltbundesamt 2019). However, alternative mobility services continue to have some weaknesses which limit their contribution to the realisation of a new mobility behaviour paradigm. For example, the fact that public transport is a station-based service that does not provide transport from an origin to a final destination, and the fact that trains, buses and trams are often overcrowded, especially during rush hours, can be seen as weaknesses.

Smart mobility apps are a special category of smartphone apps that can help to mitigate the weaknesses of alternative mobility services and thus to increase their attractiveness. According to Willing et al. (2017a, p. 271) "long-distance travel booking was the forerunner […], with many established web-based offerings, such as online travel agencies (e.g. Expedia) and flight comparison websites (e.g. Kayak), mostly due to homogeneous supply. Short-distance urban travel ['mobility' would be a more precise term], however, has recently become more diverse". Smart mobility app users are provided with individualized, context-aware, and dynamic recommendations for bundling mobility services for a trip from origin to final destination (Schulz et al. 2018). In doing so, individual customer needs and priorities, such as information about the fastest, cheapest, or most environmentally friendly bundle of mobility services are taken into account (Albrecht and Ehmke 2016; Schulz et al. 2019). To be effective, smart mobility apps must account for unforeseen events like short-term cancellations or delays automatically and in real-time, adapting recommended bundles dynamically. Such features would save customers time and energy by eliminating the need to search and compare myriad mobility service offerings, combine options and adapt their trip in response to unexpected changes. Ideally, customers should be able to book and pay for bundles or at least individual tickets using their smartphone (Willing et al. 2017a, 2017b).

Unfortunately, in reality, smart mobility apps do not provide this level of functionality. A number of studies (e.g., Albrecht and Ehmke 2016; Schulz et al. 2018; Schulz and Überle 2018; Willing et al. 2017a, 2017b) show that only few mobility providers cooperate with the providers of smart mobility apps. This has many negative effects. For example, if providers of smart mobility apps cannot access mobility provider data, their apps can only recommend a small share of all possible bundles of mobility services. In addition, the lack of provision of real-time position data limits dynamic adaptation. Furthermore, mobility providers often do not allow providers of smart mobility apps to charge customers for tickets on a 'one-click' basis.

To date, it is unclear how the shortcomings of smart mobility apps affect their value to customers. Previous research often takes a provider perspective by focusing on individual services, while neglecting the actual customer need for bundled services. This applies to different fields of service, such as education, finance, health, and in particular mobility (Alt et al. 2019; Willing et al. 2017a, 2017b). Willing et al. (2017b, p. 178) point out a potential way to close this research gap, stating that "researchers can help to identify and define *what constitutes a good intermodal* [i.e., combination of single-trip multiple mobility services] *value proposition* regarding platform [i.e., a smart mobility app] design". To date, only few studies have analysed the preference structure of potential customers, and thus how a smart mobility app should support the bundling of mobility services. Stopka (2014), for example, analyses data collected in focus group interviews with eight participants, which is not large enough to ensure representativeness. Grotenhuis et al. (2007) determine the preferences of Dutch people via a survey with multiple-choice questions. But this method is not recommended in analysing preferences (Backhaus et al. 2015). Understanding customer preference structures can help make smart mobility apps more attractive for potential customers and, hence, contribute to the reduction of private car use.

From a theoretical point of view, the shift from buying and using a private car to using a bundle of mobility services (supported by a smart mobility app) represents a shift from a goods-dominant (G-D) towards a service-dominant (S-D) logic. S-D logic literature assumes that (potential) customers evaluate the value during use, for instance, on the basis of flexibility and ease-of-use provided by smart mobility apps (Gilsing et al. 2018; Vargo et al. 2008).

Based on previous research (e.g., Circella et al. 2017; Kuhnimhof et al. 2012; Umweltbundesamt 2019), age likely significantly influences potential customer preference structures. Insights into age-related differences may help providers better tailor smart mobility apps, especially for the younger generation, which is more open to app-based mobility services (Bratzel 2018; Rayle et al. 2014). Similarly, for example, due to lower availability of alternative mobility services and often longer commuting distances, people living in rural areas likely have different preferences than people living in urban areas (Kloas et al. 2001; Umweltbundesamt 2019). A better knowledge of the preference structures and differences among potential customers can help providers develop successful business models and monetarization strategies for smart mobility apps. Research in this area is still in its infancy (Schreieck et al. 2018a). To fill the described research gap, we pose the following research questions:

RQ1: To what extent do preference structures for a smart mobility app vary across potential customers grouped by mobility behaviour?
RQ2: What effect do age and place of residence have on these preference structures?

To answer these research questions, we conducted three consecutive studies. In a first step, we analysed the customer reviews of existing smart mobility apps in order to identify relevant attributes and attribute levels. Then we conducted a pre-test with nine potential customers and one expert to identify a number of key attributes and attribute levels feasible for conjoint analysis. Finally, we conducted a conjoint analysis with 523 people living in Germany.

The paper is structured as follows: First we introduce the service-dominant (S-D) logic perspective as a means to better understanding how specific customer value is co-created in the case of smart mobility apps. Then we present different possible criteria for identifying target groups in the context of smart mobility apps. Next we present conjoint analysis as a method to analyse customer value and to gain insight into customers' smart mobility app preferences. Subsequently, we discuss the results, implications and limitations of our work and provide recommendations for future research. The article ends with a conclusion.

Conceptual foundations

The service-dominant logic perspective and its concept of value co-creation

The shift in mobility behaviour from the use of the private car to smart mobility entails a shift from a goods-dominant (G-D) towards a service-dominant (S-D) logic. The traditional G-D logic adopts a company and output-centric perspective (Vargo and Lusch 2004). It is assumed that a company focuses on the exchange of (physical) resources and primarily manufactured things. Economic value is created for the company during the transfer of ownership of goods (value-in-exchange) (Gilsing et al. 2018). The economic value is therefore determined by the company and the customer is only the recipient of the goods (Vargo and Lusch 2004; Vargo et al. 2008). However, emerging trends in the mobility sector show that "customers [are] increasingly mov[ing] away from a goods-dominant perspective (e.g. buying a car)" and considering instead "the value (e.g., the flexibility and ease-of-use) offered by [, e.g.,] car sharing applications that provide a similar mode of transportation" (Gilsing et al. 2018, p. 2).

S-D logic originated in marketing (Vargo and Lusch 2004), but scholars in a wide variety of research fields (e.g., Hearn et al. 2007; Jarvis et al. 2014; Storbacka et al. 2016), including service science (Maglio et al. 2009; Spohrer and Maglio 2010, etc.) and information systems (IS) (e.g., Brust et al. 2017; Giesbrecht et al. 2017; Lusch and Nambisan 2015; Schmidt-Rauch and Schwabe 2014) have taken an S-D logic perspective, including several studies focusing on the mobility sector (e.g., Gilsing et al. 2018; Schulz et al. 2020b; Schulz and Überle 2018; Turetken et al. 2019). One of the key assumptions of S-D logic is that service is the basis of exchange (Vargo et al. 2008). Service-for-service exchange between different actors leads to the formation of a service ecosystem that represents "a relatively self-contained, self-adjusting system of mostly loosely coupled social and economic (resource-integrating) actors connected by shared institutional logics and mutual value creation" (Lusch and Nambisan 2015, p. 161). In the case of smart mobility, the service ecosystems encompass a great number of actors, for example, mobility providers and regional authorities (Schulz et al. 2020a; Schulz and Überle 2018). The service-for-service exchange between their actors is facilitated by a service platform (Lusch and Nambisan 2015), such as a smartphone app.

In contrast to G-D logic, in S-D logic no differentiation is made between companies and customers with regard to resource integration and exchange of services (Vargo and Lusch 2004; Vargo and Lusch 2016). In other words, all actors in the service ecosystem are involved in value co-creation (Vargo and Lusch 2017). Customers act as co-creators of value, for instance, by providing smartphone data on whether a bus is delayed or overcrowded (Schreieck et al. 2018a). However, value co-creation can be constrained by conflicting institutions and institutional arrangements (Akaka et al. 2013; Koskela-Huotari et al. 2016; Schulz et al. 2020a), which reflect "humanly devised rules, norms, and beliefs" (Vargo and Lusch 2017, p. 49).

S-D logic assumes that "value is always uniquely and phenomenologically determined by the beneficiary" (Vargo et al. 2008, p. 148). Hence, the principle of value-in-exchange (G-D logic) is replaced by the principle of 'value-in-use' (Vargo and Lusch 2004) or 'value-in-context' (Chandler and Vargo 2011; Vargo and Lusch 2017; Vargo et al. 2008). Both principles are based on the assumption that service providers, based on their individual resources (e.g., capabilities, competences, knowledge, skills), can only make a value proposition. Afterwards, the value proposition is accepted or rejected by potential customers (Vargo et al. 2008). For instance, in the context of a smart mobility app, some potential customers may accept the value proposition from a provider and exchange smartphone data and money. In other cases, potential customers will reject the smart mobility app and perhaps choose an alternative. When evaluating and choosing between the value propositions of providers, potential customers are not guided by the intrinsic characteristics of smart mobility apps, but by how well these smart mobility apps create value for them in getting from an origin to a destination (Gilsing et al. 2018).

Identifying target groups for smart mobility

Segmenting the market into different "groups of [potential] customers with distinctly similar needs, service requirements and behaviour" (Hinkeldein et al. 2015, p. 180) can provide valuable insights about how smart mobility apps should be designed. As Hunecke et al. (2010, p. 4) – and similarly Semanjski and Gautama (2016) – highlight, a "knowledge about the motivational basis of target groups can be used to design interventions to promote sustainable behavior more efficiently". There are many segmentation criteria, which can be assigned to four classes: (1) mobility behaviour, (2) socio-demographic, (3) spatial, and (4) attitudinal criteria (Haustein and Hunecke 2013). Table 1 shows exemplary criteria for each class which has already been used in previous studies (e.g., Haustein and Hunecke 2013; Hinkeldein et al. 2015; Hunecke et al. 2010; Schwanen and Mokhtarian 2005; Semanjski and Gautama 2016). None of the classes or criteria can be regarded as absolutely superior. Attitudinal criteria, for example, have the disadvantage of lower reliability concerning measurability (Haustein and Hunecke 2013).

Segmentation can be conducted either a priori or post hoc. In an a priori approach, participants of a study are classified into target groups according to one or more predefined criteria (Haustein and Hunecke 2013). For example, Kawgan-Kagan (2015) differentiates between female and male early adopters of car-sharing services, and subsequently compares them on the basis of further segmentation criteria, such as socio-demographic and attitudinal criteria. In contrast, in the case of a post hoc approach, the target groups are created by drawing on the empirical data (Haustein and Hunecke 2013). Both segmentation approaches can also be combined. For instance, Siren and Haustein (2013) divide the predefined target group of baby boomers into three clusters, which significantly differ in terms of mobility behaviour and living conditions. In the following, we provide detailed information on three segmentation criteria (1) types of mobility services, (2) age, and (3) place of residence, which we will use in our study. The latter two criteria are considered particularly relevant for identifying the needs and expectations of participants for new IT services in a mobility context (Tuominen et al. 2007) such as smart mobility apps.

The mobility behaviour of the population can be characterized by the ***types of mobility services*** which are used over a certain period of time (Haustein and Hunecke 2013). Since the overall goal of this study is to provide smart mobility apps that in particular contribute to switch from private car use to the use of alternative mobility services, this is the core segmentation criterion. Previous literature (for an overview, see Grison et al. 2017) highlights that the route choice, and thus the linked choice of mobility services, depends individually on a high number of factors, including cost, travel time, and transfer characteristics. In the case of public transport, most of the routes require transfers "which are negatively perceived because they involve waiting time, walking, uncertainty, and loss of control over the trip" (Grison et al. 2017, p. 25). Similar barriers can be expected in terms of necessary transfers between all possible mobility services. Chowdhury and Ceder (2013) show that the choice of public transport routes that include transfers can be promoted if, for example, the waiting time, reliability of connection, or information is improved. On the other hand, individual mobility behaviour depends on routine and experience with mobility services, such as public transport (Grison et al. 2016). In turn, it is to be expected that the target groups created by mobility behaviour will have different preference structures for a smart mobility app.

Apart from gender, ***age*** is one of the two most frequently chosen socio-demographic segmentation criteria (Haustein and Hunecke 2013). In previous studies, the authors have analysed the mobility behaviour and the preference structures of different age groups, such as seniors (Alsnih and Hensher 2005), millennials (Circella et al. 2017), and baby boomers (Siren and Haustein 2013). Especially among the younger age groups, new lifestyles and more widely varying mobility behaviours distinguish them from other age groups. Younger generations acquire their driving licence at a later date, often do not own a car, and if they own a car, they drive less (e.g., Bratzel 2018; Circella et al. 2017; Kuhnimhof et al. 2012; Umweltbundesamt 2019). Not surprisingly, young people, in

Table 1 Exemplary segmentation criteria for the identification of target groups

Mobility behaviour criteria	Socio-demographic criteria	Spatial criteria	Attitudinal criteria
Share of mobility services	Age	Accessibility	Autonomy
Trip frequency	Gender	Distance	Excitement
Trip purpose	Household size	Place of residence	Intention
Types of mobility services	Income	Topography	Privacy
	Occupation		Status
	Level of education		

particular those who live in urban areas, are early adopters of shared mobility services (Bratzel 2018; Rayle et al. 2014). (Urban) millennials also more frequently adopt apps, for example, to obtain information about the mobility services to use for a trip, or for real-time navigation (Circella et al. 2017). In addition, an age-related segmentation of potential customers of smart mobility apps appears useful as the foundations for non-private car-based mobility are laid during earlier stages of life (Umweltbundesamt 2019). The early stages of life involve a number of events, such as moving house, starting studies and getting a first job, which are considered to have a high potential to influence the mobility behaviour (Chatterjee and Scheiner 2015).

"Where one lives also affects how travel is conducted" (Alsnih and Hensher 2005, p. 2). Different spatial criteria can be used for a corresponding segmentation (Schwanen and Mokhtarian 2005). One criterion is the ***place of residence,*** for instance, differentiating between urban, suburban, and rural areas (Haustein and Hunecke 2013). Outside of urban areas, access to public transport is often limited, which reinforces the preference for the private car (Alsnih and Hensher 2005). The effect of place of residence on mobility behaviour has also been confirmed in a number of German studies (e.g., Bratzel 2018; Scheiner and Holz-Rau 2013; Umweltbundesamt 2019). For example, Kloas et al. (2001) show that the transport volume in towns is 46 km higher per capita per week than in city centres. As a result, it can be assumed that preferences for smart mobility apps vary depending on the place of residence.

Research methodology

Choice-based conjoint (CBC) analysis

Conjoint analysis can be used to evaluate how potential customers view the value proposition offered by a provider of a smart mobility app, as well as their decision to accept or reject this value proposition. The theoretical basis for conjoint analysis was developed by scholars in the field of psychology (Luce and Tukey 1964). Today, conjoint analysis is used and well established in numerous research fields, including IS (e.g., Bajaj 2000; Berger et al. 2015; Mihale-Wilson et al. 2019; for an overview see Naous and Legner 2017; Roßnagel et al. 2014). In order to use conjoint analysis, several assumptions must be made (Backhaus et al. 2015; Hair Jr. et al. 2014). The most important assumption is that conclusions about the usefulness of individual attributes and their attribute levels can be drawn based on the evaluation of whole products or services (i.e., smart mobility apps). This is known as the decompositional approach.

For each attribute level, an estimated empirical value indicates the value for potential customers. The totality of these part-worths constitutes the potential customers' preference structure (Berger et al. 2015). The difference between the attribute level with the highest estimated part-worth and the attribute level with the lowest estimated part-worth reflects the importance of each attribute. When the difference is set in relation to the sum of the differences, the result indicates the relative importance of the attribute in the overall preference structure (Backhaus et al. 2015; Hair Jr. et al. 2014). In the decompositional approach, the total value of a smart mobility app can be calculated by adding up the estimated part-worths of its attribute levels (Hair Jr. et al. 2014). This means that the estimated part-worths of different attributes can be in a compensatory relationship to each other (Berger et al. 2015). For example, a fee-based smart mobility app (lower part-worth at the attribute app price) can provide a higher total value to potential customers compared to a free smart mobility app, and therefore be more attractive, by providing real-time information (as opposed to static information) and/or one-click booking (as opposed to being forwarded to the website).

In the course of time, the basic form of conjoint analysis has been further developed and different advanced forms have been introduced in scientific research (Hair Jr. et al. 2014). In the beginning, the most common form – so-called preference-based conjoint analysis or traditional conjoint analysis (TCA) – was to present potential customers a number of artificially constructed products or services that they have to rank or rate according to their preferences (Backhaus et al. 2015). However, both valuation methods require high mental effort on the part of participants. As a consequence, the obtained results often do not correspond to the actual preferences of potential customers (Berger et al. 2015). In order to better estimate the preferences and, thus, to more closely mimic the buying decisions of potential customers, their discrete choices can be analysed (Backhaus et al. 2015). Important contributions to the discrete choice analysis have been made by, among others, Luce (2005) and McFadden (1980). Louviere and Woodworth (1983) integrated discrete choice theory and conjoint analysis. Choice-based conjoint (CBC) analysis is now the most frequently applied form of conjoint analysis (Sattler and Hartmann 2008).

CBC analysis is a suitable and established methodology for analysing the preferences of potential customer groups for smart mobility apps. Previous studies have, for example, examined the differences in preferences between smartphone owners and non-owners with regard to newspaper subscription (Berger et al. 2015). Such insights can also help to develop monetization strategies for smart mobility apps (by including both free and non-free smart mobility apps in the choice tasks).

Implementation

Our research focuses on analysing potential customers' preferences for smart mobility apps. In order to conduct a well-grounded CBC analysis (Study 3), we carried out two preliminary studies. In Study 1, we identified a pool of attributes and their attribute levels that might be important from a customer perspective. In Study 2, we reduced the pool of attributes and attribute levels to a number feasible for CBC analysis and tested our questionnaire. Fig. 1 provides an overview of the three studies.

Study 1: Identification of attributes and attribute levels

To get a complete picture of the relevant attributes and attribute levels, we initially analysed the customer reviews provided for the smart mobility apps 'Ally', 'fromAtoB', 'Moovel', and 'Qixxit' in the Android Google Play Store (https://play.google.com) in the period from 2016 to 2017. We chose these particular smart mobility apps based on the overview provided by Albrecht and Ehmke (2016). The rationale for choosing these smart mobility apps were (1) the focus on the same geographical area (German-speaking Europe); (2) 'Moovel' (Daimler AG) and 'Qixxit' (Deutsche Bahn AG) are operated by large German companies, while 'Ally' and 'fromAtoB' are offered by start-ups; and (3) they have a varying focus on mobility within and between cities.

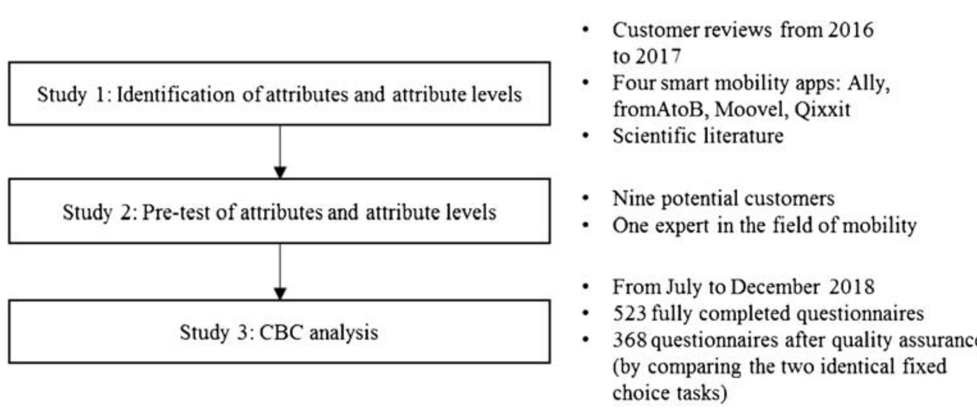
We coded our data using NVivo 10. Our analysis of negative customer reviews revealed the weaknesses of the smart mobility apps, such as the lack of integration of regional mobility providers, or the lack of ticket purchasing capability. This approach ensures that relevant attributes and attribute levels which are currently not addressed by the smart mobility apps are taken into account. Such an analysis is necessary as CBC analysis requires that "the range (low to high) of the [attribute] levels [is] set somewhat outside existing values but not at an unbelievable level" (Hair Jr. et al. 2014, p. 363). Based on scientific literature (e.g., Albrecht and Ehmke 2016; Schulz et al. 2018; Willing et al. 2017a), and on our practical experience, we added existing attributes and attribute levels from smart mobility apps. Some of them may appear standard at first if mobility services that are provided in large German cities and the related IT are chosen as reference. However, in towns and rural areas, for example real-time information and mobile tickets are often not available (Ministerium für Verkehr Baden-Württemberg 2020; Schulz et al. 2018).

Study 2: Pre-test of attributes and attribute levels

Using QuestionPro software, we then created an initial version of the questionnaire, including the choice sets, following the process steps recommended by Backhaus et al. (2015) for implementing and conducting a CBC analysis. The part of the questionnaire that encompasses the choice sets started with a short explanation of the choice decision. We used ten choice sets, eight of which were randomly designed by the software and differed from participant to participant (QuestionPro 2019). The other two choice sets were two identical fixed choice sets, or so-called 'holdouts', which were identical for each participant and necessary to measure reliability and validity (Backhaus et al. 2015; Hair Jr. et al. 2014). During one choice task, three different smart mobility apps were presented to the participants and a 'none of the above' option was included to reflect reality more closely (Backhaus et al. 2015). This fourth option permitted participants to choose a private car or any other available option or app, for instance, from a bike- or car-sharing company. A randomly designed choice set is shown in Fig. 2.

We conducted a pre-test to determine how relevant the attributes and their attribute levels are in choosing a smart mobility app, and to check if these and the supplementary questions are clearly described. Since CBC analysis should be limited to six attributes (Hair Jr. et al. 2014), our goal was to identify the six most important ones. For this purpose, we randomly selected six attributes and implemented them in QuestionPro. At the end of each pre-test, the participant was given a list of further attributes and attribute levels currently not implemented and invited to select the six most important attributes in total. Table 2 lists the attributes and attribute levels considered less important and thus not included in the final CBC analysis, as well as the corresponding original references.

Fig. 1 Overview of the studies conducted



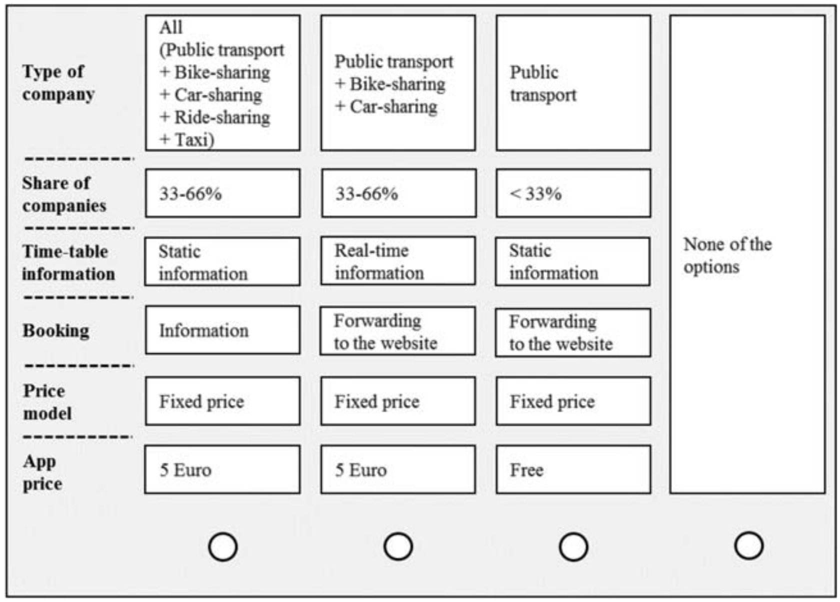


Fig. 2 A randomly designed choice set of the final CBC analysis

Regardless of the participants' selection, the app price was included as an attribute, as it plays a unique role in the CBC analysis (Hair Jr. et al. 2014). Previous studies focusing on the analysis of the willingness to pay for a (smart) mobility app, respectively, on the services provided (e.g., real-time information, alternative planning options), provide divergent results (for an overview see Pronello et al. 2017). The results of Pronello et al. (2017) show that the majority of the study participants are not willing to pay for a smart mobility app for the city of Lyon, France. One reason for this is the availability of free information on the market. The participants who were willing to pay a fee are mainly highly-educated car users travelling for work. In contrast to this, Molin and Timmermans (2006) and Zografos et al. (2012) demonstrate an increasing willingness to pay if additional services, for example, real-time information are made available. In addition, Pronello and Camusso (2015) show that German participants prefer a one-off payment for a public transport app providing real-time information, while Italian participants prefer a monthly fee.

The attribute levels of the attribute 'app price' were determined based on the prices for mobility apps in the Android Google Play Store. Many of the mobility apps in focus are free of charge since they are offered by mobility providers, such as public transport companies, to make their transport service more attractive. In contrast, several smart mobility apps, such as 'Ally' and 'fromAtoB', are offered by companies which do not themselves provide a transport service. For this reason, they must generate revenue via the smart mobility app (e.g., offering a fee-based app, selling advertising, charging a

Table 2 Attributes and attribute levels not implemented in the final CBC analysis

App provider	Medium	Focus of the app	Optimisation	Use of data	Guarantee of punctuality	Price advantage compared to single tickets
Public	Smart mobility app	Single city	Cheapest route	Improvement of mobility services	No	No
Private: Mobility sector	Smart mobility app + Smart card	Larger geographic area	Fastest route	Personalized advertising	Yes	Yes
Private: Other sector	–	–	Shortest route	–	–	–
Schulz et al. (2018); Willing et al. (2017b)	Li et al. (2005)	Albrecht and Ehmke (2016); Schulz et al. (2019); Willing et al. (2017a, 2017b); *App reviews*	Schulz et al. (2019); Willing et al. (2017a, 2017b); *App reviews*	Willing et al. (2017a)	Gil et al. (2011)	Schulz et al. (2018)

commission from mobility providers). Participants were invited to recommend improvements to the questionnaire description and justified improvements were made. The pre-test was conducted with nine potential customers and one expert from the mobility field.

Study 3: CBC analysis

All attributes and attribute levels of the final CBC analysis as well as their origin are shown in Table 3. The first attribute level of each attribute serves as the basis category and its part-worth is set to 0. The part-worths for the other attribute levels are estimated and indicate the difference to the basis category (Backhaus et al. 2015). For example, how potential customers value the consideration of a large share of companies (> 66%) and their mobility services, and thus the related possibility to adapt the bundles, for instance in case of cancellations or delays, compared to the situation where only a low share of companies (< 33%) is taken into account. The potential customers also completed the other parts of the questionnaire used to collect information about the person (e.g., gender, age, salary) and their mobility (commuting distance, use of public transport, etc.).

Data collection started in July and lasted until December 2018. The data collection focused only on Germany. Like most cities in industrialized countries, German cities suffer from problems caused by the predominant use of private cars. There is both the need and the will to address the problems. For example, due to exceeding legal limits for nitrogen oxides, courts have imposed driving bans for diesel cars in certain zones in several cities (ADAC 2019). This makes Germany a well-suited study target. The results of mobility studies in Germany (e.g., Bratzel 2018; Kuhnimhof et al. 2012; Umweltbundesamt 2019) indicate that especially for the younger generation (in particular for 18–24-year-olds), the importance of private car ownership and the emotional attachment to the car is declining, which leads to an increase in demand for mobility services. The trend towards the use of mobility services, in particular multiple mobility services in combination, is further supported by the pre-existing infrastructure, high public pressure, and legal conditions in Germany (Marx et al. 2015; Willing et al. 2017b).

To attract participants for our study, we relied heavily on Facebook. The studies by Baltar and Brunet (2012) and Kosinski et al. (2015) show that using Facebook for data collection provides the advantage of a high response rate and high data quality compared to traditional sampling strategies. We posted a short description of our study and the link to the questionnaire in applicable groups, such as those dealing with the current traffic situation in a specific region, or concepts for future mobility. Such random selection of groups helps us to mitigate a potential representation bias (Baltar and Brunet 2012). The approach also enabled us to attract participants from all over Germany with a range of mobility behaviours. In order to increase the willingness to participate, Amazon gift coupons (two each valued at 20 Euro, 50 Euro, and 75 Euro) were raffled among all participants. We collected 523 fully completed questionnaires. The comparison of the two identical holdout choice tasks showed that 155 participants chose two different smart mobility apps. In order to ensure consistency, these questionnaires were removed from the sample (Orme 2015), leaving 368 questionnaires for the estimation of the part-worths.

Data analysis

We analysed our data using SPSS. In a first step, we split our sample into three groups – mix, public transport, and private car – with regard to the mobility behaviour of the participants. This split of the sample offers two main advantages. First, practitioners can focus on the preference structure of participants who predominantly use the private car in order to address the associated mobility challenges. Second, through group comparisons, we can forecast how the preference

Table 3 Attributes and attribute levels in the final CBC analysis (└ Basis attribute levels)

Type of company	Share of companies	Time-table information	Booking	Price model	App price
Public transport └	< 33% └	Static information └	Information └	Fixed price └	Free └
Public transport + Bike-sharing + Car-sharing	33–66%	Mixed information (static and real-time information)	Forwarding to the website	Dynamic price	3 Euro
All (Public transport + Bike-sharing + Car-sharing + Ride-sharing + Taxi)	> 66%	Real-time information	One-click booking	Monthly flat-rate	5 Euro
Albrecht and Ehmke *(2016); Schulz et al. (2019); Willing et al. (2017a, 2017b); App reviews*	Schulz et al. *(2019); Willing et al. (2017a, 2017b); App reviews*	Schulz et al. *(2018); Willing et al. (2017a, 2017b); App reviews*	Schulz et al. *(2018); Willing et al. (2017a, 2017b); App reviews*	Jittrapirom et al. *(2017);* Li et al. *(2005)*	*Android Google Play Store*

structure of these participants might change if they switch to and become more familiar with alternative mobility services.

1) 'Mix' ($n = 143$): Participants who already use at least two of the following mobility services per month: public transport, car-sharing, bike-sharing, carpooling, or taxi. Some of them also use a private car during this period. Based on their experience with the use of different mobility services, these participants are best suited to assess the attributes and attribute levels of a smart mobility app. Due to their current mobility behaviour, they also seem to be the most likely buyers of smart mobility apps.
2) 'Public transport' ($n = 142$): Participants who regularly use public transport (bus, subway, tram, and train), and are familiar with its weaknesses, such as a long walking time and a lack of flexibility (Grison et al. 2017), which often result from the station-based nature of the mobility service and fixed timetables. Some participants also used a private car to better satisfy their mobility needs.
3) 'Private car' ($n = 79$): Participants who use a private car and, in part, also one mobility service other than public transport, such as occasionally calling a taxi. The smart mobility app might help remove barriers, for example for public transport use, which are faced by these participants. For instance, a monthly flat-rate can replace the complexity that is induced by the price models of the different mobility providers.

Participants ($n = 4$) who could not be assigned to any of the three groups were removed from the final analysis.

In a second step, we further subdivided the three groups according to the age and the place of residence of the participants. Bratzel (2018) finds that for 'under-25-year-olds', especially if they live in a city, private car ownership is less important, and that they are more open to app-based mobility services than people who are 'at least 25 years old'. This group belongs to the digital native generation, who "are assumed to be inherently technology-savvy" and therefore easily accept new IT (Wang et al. 2013, p. 409). For these reasons, people under 25 years old are an attractive target group for a smart mobility app. However, focusing solely on this group would cause some limitations. For example, about 60% of the German population is 25 years old or older (Statistische Ämter des Bundes und der Länder 2018). In order to alleviate the problems caused by the predominant use of private cars, it is therefore important to attract over-25-year-olds to smart mobility apps as well. Since they are comparatively less open for a change of mobility behaviour and to using smart mobility apps, it is important to know their preference structures. Furthermore, much remains unknown about how the preferences of under-25-year-olds change over time. Perhaps their preference structures will, over time, change to those of today's over-25-year-olds.

We also distinguished between people living in a 'big city' (a city with at least 100,000 inhabitants), a 'town' (a town with at least 2000 inhabitants), and a 'rural area', based on the classifications provided by the Statistisches Bundesamt (2018, 2011). The rationale for this split is that the range of mobility services and mobility providers for each mobility service available ranges depending largely on the population of the place of residence. If the number of participants in a group was at least 30, we assume a normally distributed sample in accordance with the central limit theorem (Ofungwu 2014).

Because SPSS does not provide a direct procedure for conducting CBC analysis, we applied Cox regression analysis, which is generally used for survival analysis. A stratified Cox regression maximizes the likelihood function, so-called maximum-likelihood method. This method can also be applied to estimate the part-worths in case of CBC analysis (Backhaus et al. 2015). The likelihood function as well as the underlying value and choice model are described in detail in the Supplementary Material. Using a likelihood-ratio test, we assessed the quality of each regression model (Backhaus et al. 2015). We also tested the predictive validity of the estimated part-worths by determining the corresponding hit rate. The hit rate reflects how well participants' choices can be correctly predicted using the estimated part-worths (Backhaus et al. 2015; Berger et al. 2015). To predict the choice decisions based on the estimated part-worths, we used the logit choice model, which is usually applied in CBC analysis (Backhaus et al. 2015). In order to analyse whether the estimated part-worths differed significantly between two groups of participants, we performed a t-test for independent samples (Ofungwu 2014).

Results

Sample description

The demographics of the participants are shown in Table 4. Of the participants, 60.71% were female and 39.29% were male. The participants were between 18 and 66 years old, with an average age of 25.51 years. About two-thirds of the participants (66.76%) had a monthly net income under 1300 Euro. In comparison, the average monthly net income in 2018 in Germany was 1948 Euro (Statistisches Bundesamt 2019). One reason why the average net income of our participants was below the average net income in Germany is because students were overrepresented. Another reason is that women, who are also overrepresented in our sample, earn on average less than men (Statistisches Bundesamt 2016). Approximately one third of the participants commutes less than 6 km, one third between 6 and 20 km, and one third at least 21 km. The average commute distance in Germany in 2016 was 16.91 km

(Tautz 2017). Our sample included an approximately equal number of people who do not commute to work and people who commute long distances to work, potentially between a rural area and a city.

The preference structure of participants with different existing mobility behaviour

To assess the preference structure of all three participant groups with different existing mobility behaviour, we apply Cox regression analysis. The likelihood-ratio test performed with SPSS resulted for all three regression models in a *p* value of 0.000%. In other words, each of the regression models is highly statistically significant. In addition, we tested the predictive validity of the estimated part-worths by determining the respective hit rate. They were for the different participant groups as follows: Group 1 (mix): 47.03%; group 2 (public transport): 48.77%; and group 3 (private car): 45.73%. These hit rates indicate a good degree of predictive validity compared with a hit rate of 25% in the case of random choice. The results are also comparable with those of other studies conducting CBC analysis (e.g., Kanuri et al. 2014; Wlömert and Eggers 2016).

Table 4 Demographic profile of participants

Demographic characteristic	Number	Frequency (%)
Gender:		
Male	143	39.29
Female	221	60.71
Age:		
18 to 24	215	59.07
25 to 29	88	24.18
30 to 39	36	9.89
40 to 49	17	4.67
50 to 59	6	1.65
60 to 69	2	0.55
Net income per month (in Euro):		
0 to 1300	243	66.76
1301 to 1500	16	4.40
1501 to 2000	47	12.91
2001 to 2600	33	9.07
2601 to 3600	11	3.02
3601 or more	14	3.85
Commute distance (in km):		
0 to 5	138	37.91
6 to 10	63	17.31
11 to 15	38	10.44
16 to 20	23	6.32
21 or more	102	28.02

To determine how important the individual attributes of a smart mobility app are to participants, we calculated the relative importance of the attributes. As depicted in Table 5, our results show that, for the participants in group 1, the 'app price' (32.99%) is the most important attribute followed by 'time-table information' (18.31%). The other attributes are in descending order: 'Share of companies' (16.75%), 'booking' (16.12%), 'type of company' (10.14%), and 'price model' (5.69%). Since we can assume that this participant group can best assess the actual requirements for a smart mobility app based on their previous experience with a number of different mobility services (e.g., public transport, car-sharing, or taxi), it serves as the reference group. A comparison with group 2 reveals, in particular, the lower relative importance of the attributes 'price model' (1.84%) and 'type of company' (1.68%). In contrast, the 'app price' (36.89%) is of even greater significance. When comparing the results for group 1 and 3, it is particularly noticeable that the latter attaches a much greater relative importance to the attribute 'time-table information' (27.51%), whereas they consider the attribute 'app price' (19.96%) less important.

The estimated part-worths indicate which attribute level of each attribute the participants prefer. In interpreting the results, it is important to understand that the absolute value of the estimated part-worths has no meaning. Of interest are only the differences between the different estimated part-worths of an attribute (Backhaus et al. 2015). Table 6 shows that, in particular, the estimated part-worths of the attribute levels of the attributes 'type of company' and 'price model' are not significant in the majority of cases. The mean differences were computed based on group 1 as reference. On the basis of the mean differences and the standard deviations (SD), we carried out two t-tests, which showed that the estimated part-worths differ significantly, with the exception of the attribute level 'one-click booking'. For instance, we observed that the participants belonging to group 3 assigned significantly lower negative values to the '3 Euro' and '5 Euro' attribute level of the attribute 'app price'. Hence, a price increase only leads to a comparatively small decline in value.

The effect of age on the preference structure

To analyse the effect of age on the preference structure of the participants, we further divided the three participant groups into two age groups (under-25-years-old and at least 25 years old) following the lead of previous studies (e.g., Bratzel 2018; Wang et al. 2013) identifying under-25-year-olds as more likely customers of smart mobility apps. Using the likelihood-ratio test, each of the regression models can be considered highly significant with a *p* value of 0.000%. The hit rate for the assessment of predictive validity varies between 46.67% for group 4 (private car and < 25 years old) and 53.13% for group 3 (public transport and < 25 years old).

Table 5 Relative importance of attributes (in %)

Attribute	Group 1: Mix ($n = 143$)	Group 2: Public transport ($n = 142$)	Group 3: Private car ($n = 79$)
Type of company	10.14	1.68	6.18
Share of companies	16.75	17.62	19.00
Time-table information	18.31	23.04	27.51
Booking	16.12	18.92	20.38
Price model	5.69	1.84	6.98
App price	32.99	36.89	19.96

The other hit rates are 48.15% for group 1 (mix and ≥ 25 years old) as well as 49.44% for group 2 (mix and < 25 years old). The results for the remaining two groups are provided in the Supplementary Material.

A comparison of the participant groups 2 and 3 shows that their relative importance for the attributes is very similar (see Table 7). Only the attribute 'type of company', which is more than twice as important for participants from group 2, varies considerably (10.22% to 4.32%). In contrast, the results for the relative importance of the attributes for group 4 are very different. In particular, the attribute 'app price' with a relative importance of only 17.70% no longer occupies a prominent position among the attributes. On the other hand, especially the relative importance of the attributes 'time-table information' (27.09%) and 'price model' (10.25%) increases compared with the reference group 2. In order to determine the effect of age, we calculate the relative importance of attributes for group 1. The results show that older participants attach less importance to the attribute 'app price' (19.76%), but a higher relative importance to the attributes 'booking' (19.78%) and 'price model' (11.24%).

The results for the estimated part-worths, their standard deviation (SD), and each calculated mean difference of the estimated part-worths for performing t-tests are depicted in Table 8. The mean differences were calculated with group 2 as reference group. The results show that group 2 has a significantly lower estimated part-worth for the attribute level 'mixed information' (0.225) compared to groups 3 and 4 (public transport: 0.524, and private car: 0.441). The situation is identical for 'real-time information', with an estimated part-worth of 0.463 compared to 0.621 and 0.666. The effect of age on the preference structure of participants is further revealed by comparing groups 1 and 2. For example, group 1 with the older participants has a significantly higher estimated part-worth than group 2 in the case of 'real-time information' (0.624 compared to 0.463) and 'one-click booking' (0.588 compared to 0.375).

Table 6 Part-worths for attribute levels (*p < 0.10; **p < 0.05; ***p < 0.01)

Attribute level	Group 1: Mix ($n = 143$)		Group 2: Public transport ($n = 142$)			Group 3: Private car ($n = 79$)		
	Part-worths	*SD*	*Part-worths*	*SD*	*Mean difference*	*Part-worths*	*SD*	*Mean difference*
Public transport + Bike-sharing + Car-sharing	0.114	0.084	0.006	0.078	−0.108	−0.089	0.107	−0.203
All	0.288***	0.080	−0.035	0.079	−0.323	0.054	0.106	−0.234
33–66%	0.349***	0.084	0.295***	0.083	−0.054***	0.250**	0.115	−0.099***
> 66%	0.475***	0.082	0.429***	0.081	−0.046***	0.440***	0.110	−0.035**
Mixed information	0.291***	0.086	0.465***	0.084	0.174***	0.418***	0.117	0.126***
Real-time information	0.520***	0.082	0.561***	0.083	0.041***	0.637***	0.110	0.118***
Forwarding to the website	0.183**	0.085	0.222***	0.084	0.039***	0.185	0.116	0.002
One-click booking	0.458***	0.079	0.461***	0.079	0.003	0.472***	0.107	0.015
Dynamic price	−0.074	0.078	−0.045	0.079	0.030	−0.162	0.106	−0.087
Monthly flat-rate	−0.161**	0.080	−0.023	0.078	0.139	−0.056	0.105	0.105
3 Euro	−0.530***	0.075	−0.580***	0.075	−0.051***	−0.336***	0.102	0.194***
5 Euro	−0.937***	0.085	−0.899***	0.084	0.038***	−0.462***	0.107	0.474***
None	−0.066	0.144	−0.319**	0.147	−0.253	−0.135	0.198	−0.069

Table 7 Relative importance of attributes (in %)

Attribute	Group 1: Mix ≥ 25 years old (n = 54)	Group 2: Mix < 25 years old (n = 89)	Group 3: Public transport < 25 years old (n = 96)	Group 4: Private car < 25 years old (n = 30)
Type of company	10.54	10.22	4.32	14.05
Share of companies	17.71	15.75	17.42	14.39
Time-table information	20.98	16.57	22.54	27.09
Booking	19.78	13.41	15.26	16.52
Price model	11.24	2.36	3.31	10.25
App price	19.76	41.70	37.15	17.70

The effect of place of residence on the preference structure

To determine the effect of place of residence on the preference structure, we focus on the comparison of participants who use multiple mobility services and live either in a big city (group 1) or town (group 2). The reason for this selection is that the range of mobility services available (e.g., car-sharing, subway) in Germany tends to vary depending on the size of the city/town, and thus probably also influences the preference structure. In addition, we examine the participants who predominantly use a private car and live in a rural area (group 3) because these participants contribute to mobility problems, such as traffic congestion and lack of parking spaces if their place of work is in a city or town. The likelihood-ratio test resulted each in a p value of 0.000%. The hit rates are: 48.63% for group 1, 46.76% for group 2, and 49.58% for group 3. The results for all other groups are made available in the Supplementary Material.

For each of the three groups, the attributes' relative importance is shown in Table 9. In comparing groups 1 and 2, especially large differences in relative importance for the attributes 'type of company', 'booking', and 'app price' were observed. The results for group 3 are comparable with the results for the analysis without considering the effect of the place of residence on the preference structure (see Table 5).

Table 10 provides an overview of the estimated part-worths for the three groups. The results show that, with the exception of two cases, the estimated part-worths for the attribute levels for the attributes 'type of company' and 'price model' are not significant. The mean differences were calculated based on group 1 as reference. The t-test carried out demonstrates that there are also no significant differences between groups 1 and 2 with regard to 'mixed information' and 'real-time information'. However, the estimated part-worths for group 3 are significantly higher (0.488 and 0.693) than those of group 1. In addition, there are significant differences between groups 2 and 3 vis-à-vis group 1 with regard to the attribute level 'one-click booking'. While the participants of group 3 have significantly lower negative estimated part-worths for both attribute levels ('3 Euro' and '5 Euro') of the attribute 'app price' than the participants belonging to group 1, this is only the case for '5 Euro' for the participants of group 2.

Discussion

Theoretical implications

We contribute to the IS and S-D logic literature (e.g., Brust et al. 2017; Schulz et al. 2020b) by analysing the preference structures of potential customers for smart mobility apps using CBC analysis. The intended behaviour change away from using a private car (G-D logic) towards using alternative mobility services requires the adoption of the S-D logic perspective with its concept of value co-creation (Gilsing et al. 2018; Vargo and Lusch 2004). S-D logic literature highlights the central role of the customer as co-creator of value (Vargo and Lusch 2017), and that the value is uniquely determined by each individual beneficiary (Vargo et al. 2008). Companies, such as providers of smart mobility apps, can only make value propositions that are accepted or rejected by potential customers (Vargo et al. 2008). However, to date, there are only a few studies (Grotenhuis et al. 2007; Stopka 2014) with methodological shortcomings that examine the preference structures of potential customers for smart mobility apps. The results of our preliminary studies and the CBC analysis provide detailed insights into the attributes, the attribute levels, the relative importance of attributes, and the estimated part-worth for each attribute level on which the choice of three participant groups with different existing mobility behaviour is based. For instance, we observed that the participants who predominantly use a private car attach much less relative importance to the attribute 'app price' than the other participant groups. In addition, they assigned significantly lower negative part-worths to the '3 Euro' and '5 Euro' attribute level compared to participants who use two or more different mobility services per month. These examples illustrate how our approach helps illuminate factors that motivate

Table 8 Part-worths for attribute levels (*p < 0.10; **p < 0.05; ***p < 0.01)

Attribute level	Group 1: Mix ≥ 25 years old (*n* = 54)			Group 2: Mix < 25 years old (*n* = 89)		Group 3: Public transport < 25 years old (*n* = 96)			Group 4: Private car < 25 years old (*n* = 30)		
	Part-worths	*SD*	*Mean difference*	*Part-worths*	*SD*	*Part-worths*	*SD*	*Mean difference*	*Part-worths*	*SD*	*Mean difference*
Public transport + Bike-sharing + Car-sharing	0.181	0.136	0.108	0.073	0.107	0.014	0.093	−0.059	−0.082	0.180	−0.155
All	0.313**	0.130	0.028	0.286***	0.101	−0.105	0.095	−0.390	0.264	0.173	−0.022
33–66%	0.414***	0.137	0.102***	0.312***	0.107	0.276***	0.101	−0.036**	0.164	0.182	−0.148
> 66%	0.526***	0.133	0.086***	0.440***	0.105	0.480***	0.097	0.040***	0.354**	0.177	−0.086**
Mixed information	0.423***	0.141	0.198***	0.225**	0.108	0.524***	0.101	0.299***	0.441**	0.185	0.216***
Real-time information	0.624***	0.136	0.161***	0.463***	0.104	0.621***	0.100	0.158***	0.666***	0.177	0.203***
Forwarding to the website	0.256*	0.140	0.122	0.134	0.107	0.201**	0.101	0.067	0.244	0.185	0.110
One-click booking	0.588***	0.129	0.213***	0.375***	0.101	0.421***	0.095	0.046***	0.406**	0.176	0.032
Dynamic price	−0.154	0.125	−0.126	−0.029	0.101	−0.047	0.096	−0.018	−0.202	0.174	−0.173
Monthly flat-rate	−0.334**	0.131	−0.268	−0.066	0.101	0.045	0.093	0.110	0.050	0.168	0.116
3 Euro	−0.280**	0.123	0.390***	−0.669***	0.096	−0.673***	0.090	−0.003	−0.377**	0.167	0.293***
5 Euro	−0.587***	0.133	0.578***	−1.165***	0.112	−1.024***	0.105	0.141***	−0.436**	0.170	0.730***
None	0.181	0.239	0.387	−0.205	0.182	−0.481***	0.180	−0.276	−0.266	0.325	−0.061

Table 9 Relative importance of attributes (in %)

Attribute	Group 1: Mix Big city ($n = 64$)	Group 2: Mix Town ($n = 54$)	Group 3: Private car Rural area (n = 30)
Type of company	4.40	16.50	6.42
Share of companies	14.10	17.03	13.91
Time-table information	17.39	19.76	24.83
Booking	20.09	12.43	24.63
Price model	6.94	4.82	7.96
App price	37.17	29.46	22.25

different potential customers to enter into a value co-creation relationship.

Our research shows the effect of age and place of residence on the preference structures of potential smart mobility app customers. According to S-D logic (Akaka et al. 2013; Koskela-Huotari et al. 2016; Schulz et al. 2020a; Vargo and Lusch 2017; Vargo et al. 2015), value co-creation can be constrained by conflicting institutions and institutional arrangements (rules, norms, and beliefs). Literature on digital natives (e.g., Wang et al. 2013) suggests that especially older generations have problems accepting new IT, such as a smart mobility app, which indicate conflicting institutions and institutional arrangements that affect their (mobility) behaviour. In contrast, the 18–24-year-olds are much more open-minded towards app-based mobility services (Bratzel 2018; Rayle et al. 2014). In addition, this age group considers private car ownership less important than other age groups, and they are less emotionally attached to cars (Circella et al. 2017; Kuhnimhof et al. 2012; Umweltbundesamt 2019). The results of our CBC analysis show that age differences also influence preference structures for smart mobility apps. For example, for participants under 25 years old who use at least two mobility services per month, the 'app price' has a very high relative importance (41.70%) in comparison with participants who are at least 25 years old (19.76%). Interestingly, this result is not reflected in the relative importance for the attribute 'price model' (2.36% compared to 11.24%). When looking at the further results for those two groups, it is particularly noticeable that the younger participants have significant lower estimated part-worths for the attribute levels 'real-time information' and 'one-click booking'. One possible explanation is that digital natives tend to find it easy to use various apps simultaneously to find an alternative mobility service in case of a delay or in order to purchase tickets from individual mobility providers.

Earlier studies (e.g., Bratzel 2018; Umweltbundesamt 2019) suggest that the place of residence has an effect on the preference structures of potential customers. The results of our CBC analysis reveal, in particular, that participants using at least two mobility services and who live in a town attribute the

Table 10 Part-worths for attribute levels (*p < 0.10; **p < 0.05; ***p < 0.01)

Attribute level	Group 1: Mix Big city ($n = 64$)		Group 2: Mix Town ($n = 54$)			Group 3: Private car Rural area ($n = 30$)		
	Part-worths	*SD*	*Part-worths*	*SD*	*Mean difference*	*Part-worths*	*SD*	*Mean difference*
Public transport + Bike-sharing + Car-sharing	0.052	0.124	0.169	0.139	0.117	0.026	0.175	−0.027
All	0.131	0.117	0.462***	0.130	0.331	0.179	0.175	0.048
33–66%	0.272**	0.125	0.404***	0.137	0.132***	0.378**	0.189	0.106***
> 66%	0.421***	0.122	0.477***	0.135	0.056**	0.388**	0.178	−0.033
Mixed information	0.278**	0.128	0.267*	0.141	−0.011	0.488**	0.190	0.210***
Real-time information	0.517***	0.122	0.554***	0.133	0.037	0.693***	0.180	0.176***
Forwarding to the website	0.217*	0.132	0.175	0.136	−0.042	0.437**	0.203	0.220***
One-click booking	0.600***	0.120	0.348***	0.129	−0.251***	0.687***	0.190	0.087**
Dynamic price	−0.151	0.119	−0.135	0.128	0.016	−0.222	0.176	−0.071
Monthly flat-rate	−0.207*	0.118	−0.115	0.128	0.092	−0.034	0.165	0.173
3 Euro	−0.568***	0.111	−0.553***	0.125	0.014	−0.389**	0.167	0.179***
5 Euro	−1.109***	0.135	−0.826***	0.132	0.284***	−0.621***	0.175	0.489***
None	−0.227	0.219	−0.091	0.235	0.136	0.078	0.344	0.304

greatest relative importance to the attribute 'type of company' (16.50%). In addition, they are the only group who has a significant estimated part-worth for the attribute level 'all' (0.462). A possible reason for this might be that in big German cities public transport already includes a larger range of mobility services, potentially including subway and tram. Moreover, big cities usually have a close-knit network of transport stations that provides access to a variety of public transport services. As a consequence, this group may attribute less relative importance to alternative mobility services such as bike-sharing. In contrast, several mobility services (e.g., car- and ride-sharing) are often scarce or not present in rural areas, which could explain the lack of significance for the group of participants who currently drive a private car.

With regard to 'mixed information' and 'real-time information' of the attribute 'time-table information' no significant differences could be identified between participants who use at least two mobility services and live in big cities or towns. However, the group of participants who currently predominantly use a private car and live in a rural area attributed significantly higher estimated part-worths to these attribute levels. This could be explained by the fact that these participants have to wait a long time due to low timetable density and lack of alternative mobility services if, for example, they miss their bus due to a train delay.

In the case of the attribute level 'one-click booking', participants who use multiple mobility services and live in a town display a significantly lower estimated part-worth (0.348) than those who live in a big city. One possible reason could be that there is a higher number of mobility services as well as more mobility providers for each mobility service in big cities. As a result, this participant group must use a variety of apps from different mobility providers, which they would not have to do using one-click booking. In contrast, the group of participants who predominantly use a private car and live in a rural area has a significantly higher estimated part-worth (0.687). One reason for this could be that these participants can benefit most from this simplified form of ticket purchase due to their lack of experience. Another reason could be that these participants often can only buy paper-based tickets (Schulz et al. 2018) and now would have the opportunity to purchase digital tickets through the smart mobility app. Overall, the results of our CBC analysis indicate that the focus on a specific urban area, as commonly chosen in the smart city literature (e.g., Brauer et al. 2015; Yadav et al. 2017), is often too narrow to fully address the mobility challenges, as commuters from rural areas that predominantly use a private car have divergent needs and preferences.

Practical implications

One practical implication of our study pertains to how providers of smart mobility apps can better put value co-creation with potential customers into practice. Previous studies (Albrecht and Ehmke 2016; Alt et al. 2019; Willing et al. 2017a, 2017b) show that smart mobility is currently more of a vision than a reality, since the smart mobility apps have a number of limitations. For example, only a small number of mobility providers and their mobility services are taken into account. While there are first insights about why mobility providers do not cooperate (e.g., Schulz et al. 2018; Schulz et al. 2020b; Schulz and Überle 2018), the resulting consequences for the attraction of potential customers had been unclear due to methodological shortcomings of previous studies (Grotenhuis et al. 2007; Stopka 2014). The results of our CBC analysis can help providers design a smart mobility app that is attractive to potential customers. For instance, providers can compensate for a relatively low value due to a small proportion of mobility providers by improving the remaining attributes, such as by implementing one-click booking. A higher overall value also always goes hand in hand with a higher willingness to pay (Berger et al. 2015). In turn, this could make mobility providers more willing to cooperate with providers of smart mobility apps, which could further increase value co-creation.

Second, our results have implications for improving the business model of providers of smart mobility apps. According to Willing et al. (2017b, p. 178), IS research can help to create a new mobility paradigm by adopting a business model perspective to evaluate "the quality and the success factors of the different intermodal solutions". Our CBC analysis reveals the preference structures of potential customers and thus the success factors of a smart mobility app. The results also confirm that there are significant group differences with regard to the age and the place of residence of potential customers. Providers of smart mobility apps can thus develop a sustainable business model by offering a high value proposition to a specific target group, and thus differentiate themselves from competitors. For example, our study indicates that potential customers under 25 years old who use at least two mobility services can be offered a flat-rate, while people over 25 years old should be offered a fixed price. The target group's preference structure also has implications for the relevance of activities and resources. For instance, it is less important for a business model targeting big city dwellers who use at least two mobility services to cooperate with different types of companies (e.g., bike-sharing and taxi), than for a business model targeting town dwellers. Hence, this research contributes to the emerging literature on business models in the smart mobility domain (Gilsing et al. 2018; Turetken et al. 2019).

Finally, we contribute to research on monetarization strategies for smart mobility apps, which is still in its infancy. Based on interviews with three experts, Schreieck et al. (2018a) recommend that customers should be subsidized, for example through a service free of charge or a welcome bonus, while city administrations should be charged. By integrating the 'app price' attribute into our CBC analysis, we show when it is possible to charge customers and when it makes more sense to charge city administrations. City administrations should be charged when the sum of the estimated part-worths would be negative or zero at the choice of a specific price. Especially in the case of participants who predominantly use a private car, the relative importance for the attribute 'app price', as well as the corresponding estimated part-worths for '3 Euro' and '5 Euro' are relatively low, so charging the customer is conceivable.

Limitations and further research

Although we conducted our study with the greatest possible care, it has some limitations which should be addressed by future research. First of all, our analyses are limited to Germany. Several authors have concluded that Germany represents a suitable environment due to its pre-existing infrastructure, high public pressure, and legal conditions (Marx et al. 2015; Willing et al. 2017b). In addition, attitudes toward private car ownership are changing among the younger generations (Bratzel 2018; Kuhnimhof et al. 2012; Umweltbundesamt 2019). Nevertheless, our results should be verified in other countries to account for country-specific and cultural factors.

Second, in order to attract participants for our study, we relied heavily on Facebook. This results in a bias towards young people. We did, however, ensure that every group contained at least 30 participants, the prerequisite for expecting a normal distribution (Ofungwu 2014). In addition, the sample was also split according to age, which enables us to take into account the greater participation of younger people. In other group comparisons, however, an age bias could exist, which makes further studies necessary. From a practical point of view, the focus on younger people offers an important advantage, since foundations for the implementation of non-private car-based mobility are laid during the early stages of life (Umweltbundesamt 2019).

Third, in addition to age, we rely on the types of mobility services that are used by the participants in a certain period of time (Haustein and Hunecke 2013), and the place of residence (Alsnih and Hensher 2005; Haustein and Hunecke 2013) to define potential customer groups. However, besides these criteria, there are numerous other segmentation criteria (see Table 1) which can be used in future work. Especially the use of the criterion 'trip purpose' (Semanjski and Gautama 2016; Xiao et al. 2016) promises new and deeper insights into the preference structures of potential customers for a smart mobility app. A corresponding indication can be found in the results of Pronello et al. (2017) according to which participants with a lower share of trips to work and a higher share for leisure and shopping trips are unwilling to pay for a smart mobility app. In contrast, in particular participants who use their private car for driving to work are willing to pay for a smart mobility app.

Fourth, the choice of CBC analysis as method of investigation causes some limitations. We assume that the acquisition of a smart mobility app will lead to a decline in the use of the private car and instead will promote the use of alternative mobility services. However, while CBC analysis is the best method to mimic the real choice decision of potential customers (Backhaus et al. 2015; Berger et al. 2015), it does not allow conclusions to be drawn about the use of the smart mobility app after the purchase. Future research should therefore examine continued use patterns across different groups of buyers. In addition, the relationship between the use of the smart mobility app and a possible behavioural change should be explored. In particular, long-term studies should be carried out as mobility behaviour changes over time.

While the focus of the present study is on determining the preference structure for different groups of potential customers, future work may use CBC analysis to determine their willingness to pay for smart mobility apps (Naous and Legner 2017). Furthermore, the focus of CBC analysis is on the attributes and attribute levels of the smart mobility apps, in other words, on how techno-economic characteristics affect choice decision (Naous and Legner 2017). The results of Schikofsky et al. (2020) show, however, that in the present context the intention to adopt a smart mobility app might also depend on further motivational factors, such as hedonic motives (e.g., fun, pleasure), perceived usefulness (e.g., perceived efficiency and performance) and perceived ease of use. Hence, in order to understand the acceptance of smart mobility apps in it's entirely, the results of the present study should be used to inform further research that adopts the Technology Acceptance Model (TAM). An interdisciplinary overview of the different methods usable for the analysis of technology acceptance is provided by Head and Ziolkowski (2012).

Sixth, we are subject to some limitations in the interpretation of the results of our CBC analysis. Potential customers are often already more or less tied to a specific mobility provider by a customer loyalty program (e.g., a discount card), or at least influenced in their choice by previous experience with a mobility provider and its mobility service. Due to the high complexity, our CBC analysis does not take into account the corresponding relationships. Future research could use experiments for such investigations. In addition, our results show that the attribute levels of 'price model' in general have no significant effect on the choice decision. Future studies should examine whether dynamic pricing can be used to increase the use of mobility services and the revenues they generate.

Conclusion

Achieving smart mobility, defined as the IT-supported bundling of different mobility services to get from origin to destination, is seen as an important contribution to reducing the predominant use of the private car, and to solving associated mobility-related challenges. Our approach is novel in that we analyse the preference structures of different potential customer groups for a smart mobility app. In particular, we take into account the effect of potential customers' age and place of residence. A CBC analysis and the necessary preliminary studies were carried out in Germany. Our results indicate, among other things, that the app price is often the most important attribute affecting whether individuals choose one smart mobility app over another. In the group of participants who predominantly use a private car, however, the app price does not play a significant role, regardless of age and place of residence.

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References

ADAC (2019). *Dieselfahrverbot: Alle Fragen und Antworten*. URL: https://www.adac.de/rund-ums-fahrzeug/abgas-diesel-fahrverbote/fahrverbote/dieselfahrverbot-faq/. Accessed 29 Jan 2019.

Akaka, M. A., Vargo, S. L., & Lusch, R. F. (2013). The complexity of context: A service ecosystems approach for international marketing. *Journal of International Marketing, 21*(4), 1–20. https://doi.org/10.1509/jim.13.0032.

Albrecht, L., & Ehmke, J. F. (2016). *Innovative Services in der Mobilitätsbranche: Eine Marktanalyse Multimodaler Mobilitätsmanager*. Ilmenau: Multikonferenz Wirtschaftsinformatik.

Alsnih, R. & Hensher, D, A. (2005). Travel behaviour of seniors in an aging population: An exploratory study of trip chains and modal preferences in the greater metropolitan area of Sydney. *Road and Transport Research, 14*(4), 60–72.

Alt, R., Ehmke, J. F., Haux, R., Henke, T., Mattfeld, D. C., Oberweis, A., Paech, B., & Winter, A. (2019). Towards customer-induced service orchestration - requirements for the next step of customer orientation. *Electronic Markets, 29*(1), 79–91. https://doi.org/10.1007/s12525-019-00340-3.

Backhaus, K., Erichson, B., & Weiber, R. (2015). *Fortgeschrittene Multivariate Analysemethoden: Eine anwendungsorientierte Einführung*. Berlin: Springer Gabler.

Bajaj, A. (2000). A study of senior information systems managers' decision models in adopting new computing architectures. *Journal of the Association for Information Systems, 1*(1), 1–58. https://doi.org/10.17705/1jais.00004.

Baltar, F., & Brunet, I. (2012). Social research 2.0: Virtual snowball sampling method using Facebook. *Internet Research, 22*(1), 57–74. https://doi.org/10.1108/10662241211199960.

Benevolo, C., Dameri, R. P., & D'Auria, B. (2016). Smart mobility in smart city: Action taxonomy, ICT intensity and public benefits. In T. Torre, A. M. Braccini, & R. Spinelli (Eds.), *Empowering organizations: Enabling platforms and artefacts* (pp. 13–28). Cham: Springer.

Berger, B., Matt, C., Steininger, D. M., & Hess, T. (2015). It is not just about competition with "free": Differences between content formats in consumer preferences and willingness to pay. *Journal of Management Information Systems, 32*(3), 105–128. https://doi.org/10.1080/07421222.2015.1095038.

Bratzel, S. (2018). Junge Generation und die Mobilität der Zukunft. URL: https://www.auto-institut.de/index_htm_files/Pressemitteilung_Mobilitaet_Junge%20Generation.pdf. Accessed 16 Dec 2018.

Brauer, B., Eisel, M., & Kolbe, L. M. (2015). *The state of the art in smart city research - a literature analysis on green IS solutions to foster environmental sustainability*. Singapore: Pacific Asia Conference on Information Systems.

Brust, L., Breidbach, C. F., Antons, D., & Salge, T. O. (2017). *Service-dominant logic and information systems research: A review and analysis using topic modeling*. Seoul: International Conference on Information Systems.

Chandler, J. D., & Vargo, S. L. (2011). Contextualization and value-in-context: How context frames exchange. *Marketing Theory, 11*(1), 35–49. https://doi.org/10.1177/1470593110393713.

Chatterjee, K. & Scheiner J. (2015). Understanding changing travel behaviour over the life course: Contributions from biographical research. Windsor: International Conference on Travel Behaviour Research.

Chowdhury, S., & Ceder, A. (2013). A psychological investigation on public-transport users' intention to use routes with transfers. *International Journal of Transportation, 1*(1), 1–20. https://doi.org/10.14257/ijt.2013.1.1.01.

Circella, G., Alemi, F., Tiedeman, K., Berliner R, M., Lee, Y., Fulton, L., Mokhtarian, P, L. & Handy, S. (2017). What affects millennials' mobility? Part II: The impact of residential location, individual preferences and lifestyles on young adults' travel behavior in California. https://escholarship.org/uc/item/5kc117kj.

Firnkorn, J., & Müller, M. (2011). What will be the environmental effects of new free-floating car-sharing systems? The case of Car2Go in Ulm. *Ecological Economics, 70*(8), 1519–1528. https://doi.org/10.1016/j.ecolecon.2011.03.014.

Giesbrecht, T., Schwabe, G., & Schenk, B. (2017). Service encounter thinklets: How to empower service agents to put value co-creation into practice. *Information Systems Journal, 27*(2), 171–196. https://doi.org/10.1111/isj.12099.

Gil, A., Calado, H., & Bentz, J. (2011). Public participation in municipal transport planning processes – The case of the sustainable mobility plan of Ponta Delgada, Azores, Portugal. *Journal of Transport Geography, 19*(6), 1309–1319. https://doi.org/10.1016/j.jtrangeo.2011.06.010.

Gilsing, R., Turetken, O., Adali, O. E., & Grefen, P. (2018). *A reference model for the design of service-dominant business models in the smart mobility domain*. San Francisco: International Conference on Information Systems.

Grison, E., Gyselinck, V., & Burkhardt, J.-M. (2016). Exploring factors related to users' experience of public transport route choice: Influence of context and users profiles. *Cognition, Technology & Work, 18*(2), 287–301. https://doi.org/10.1007/s10111-015-0359-6.

Grison, E., Burkhardt, J.-M., & Gyselinck, V. (2017). How do users choose their routes in public transport? The effect of individual profile and contextual factors. *Transportation Research Part F: Traffic Psychology and Behaviour, 51*, 24–37. https://doi.org/10.1016/j.trf.2017.08.011.

Grotenhuis, J.-W., Wiegmans, B. W., & Rietveld, P. (2007). The desired quality of integrated multimodal travel information in public transport: Customer needs for time and effort savings. *Transport Policy, 14*(1), 27–38. https://doi.org/10.1016/j.tranpol.2006.07.001.

Hair Jr., J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2014). *Multivariate data analysis*. Harlow: Pearson Education.

Haustein, S., & Hunecke, M. (2013). Identifying target groups for environmentally sustainable transport: Assessment of different segmentation approaches. *Current Opinion in Environmental Sustainability, 5*(2), 197–204. https://doi.org/10.1016/j.cosust.2013.04.009.

Head, M., & Ziolkowski, N. (2012). Understanding student attitudes of mobile phone features: Rethinking adoption through conjoint, cluster and SEM analyses. *Computers in Human Behavior, 28*(6), 2331–2339. https://doi.org/10.1016/j.chb.2012.07.003.

Hearn, G., Roodhouse, S., & Blakey, J. (2007). From value chain to value creating ecology: Implications for creative industries development policy. *International Journal of Cultural Policy, 13*(4), 419–436. https://doi.org/10.1080/10286630701683367.

Hildebrandt, B., Hanelt, A., Piccinini, E., Kolbe, L. M., & Nierobisch, T. (2015). *The value of IS in business model innovation for sustainable mobility services - the case of carsharing* (pp. 1008–1022). Osnabrück: *International Conference on Wirtschaftsinformatik*.

Hinkeldein, D., Schoenduwe, R., Graff, A., & Hoffmann, C. (2015). Who would use integrated sustainable mobility services – And why? *Sustainable Urban Transport, 7*, 177–203. https://doi.org/10.1108/s2044-994120150000007019.

Hunecke, M., Haustein, S., Böhler, S., & Grischkat, S. (2010). Attitude-based target groups to reduce the ecological impact of daily mobility behavior. *Environment and Behavior, 42*(1), 3–43. https://doi.org/10.1177/0013916508319587.

Jarvis, W., Halvorson, W., Sadeque, S., & Johnston, S. (2014). A large class engagement (LCE) model based on service-dominant logic (SDL) and flipped classrooms. *Education Research and Perspectives, 41*, 1–24.

Jittrapirom, P., Caiati, V., Feneri, A.-M., Ebrahimigharehbaghi, S., Alonso-González, M. J., & Narayan, J. (2017). Mobility as a service: A critical review of definitions, assessments of schemes, and key challenges. *Urban Planning, 2*(2), 13–25. https://doi.org/10.17645/up.v2i2.931.

Kanuri, V. K., Thorson, E., & Mantrala, M. K. (2014). Using reader preferences to optimize news content: A method and a case study. *International Journal on Media Management, 16*(2), 55–75. https://doi.org/10.1080/14241277.2014.943898.

Kawgan-Kagan, I. (2015). Early adopters of Carsharing with and without Bevs with respect to gender preferences. European Transport Research Review 7.

Kloas, J., Kuhfeld, H. & Kunert, U. (2001). Dynamik des Verkehrsverhaltens im Jahresvergleich. Analyse des Deutschen Mobilitätspanels 1994 bis 1999. *Deutsches Institut für Wirtschaftsforschung*. https://www.diw.de/documents/dokumentenarchiv/17/38797/diw_MOP_200111.pdf.

Kosinski, M., Matz, S. C., Gosling, S. D., Popov, V., & Stillwell, D. (2015). Facebook as a research tool for the social sciences: Opportunities, challenges, ethical considerations, and practical guidelines. *American Psychologist, 70*(6), 543–556. https://doi.org/10.1037/a0039210.

Koskela-Huotari, K., Edvardsson, B., Jonas, J. M., Sörhammar, D., & Witell, L. (2016). Innovation in service ecosystems—Breaking, making, and maintaining institutionalized rules of resource integration. *Journal of Business Research, 69*(8), 2964–2971. https://doi.org/10.1016/j.jbusres.2016.02.029.

Kuhnimhof, T., Armoogum, J., Buehler, R., Dargay, J., Denstadli, J. M., & Yamamoto, T. (2012). Men shape a downward trend in car use among young adults—Evidence from six industrialized countries. *Transport Reviews, 32*(6), 761–779. https://doi.org/10.1080/01441647.2012.736426.

Li, T., van Heck, E., & Vervest, P. (2005). *How smart card technology could be used for dynamic pricing in transportation network?* Hong Kong: International Conference on Electronic Business.

Louviere, J. J., & Woodworth, G. (1983). Design and analysis of simulated consumer choice or allocation experiments: An approach based on aggregate data. *Journal of Marketing Research, 20*(4), 350–367. https://doi.org/10.2307/3151440.

Luce, R. D. (2005). *Individual choice behavior: A theoretical analysis*. New York: Dover Publications.

Luce, R. D., & Tukey, J. W. (1964). Simultaneous conjoint measurement: A new type of fundamental measurement. *Journal of Mathematical Psychology, 1*(1), 1–27. https://doi.org/10.1016/0022-2496(64)90015-x.

Lusch, R. F., & Nambisan, S. (2015). Service innovation: A service-dominant logic perspective. *MIS Quarterly, 39*(1), 155–175. https://doi.org/10.25300/misq/2015/39.1.07.

Maglio, P. P., Vargo, S. L., Caswell, N., & Spohrer, J. (2009). The service system is the basis abstraction of service science. *Information Systems and e-Business Management, 7*(4), 395–406. https://doi.org/10.1007/s10257-008-0105-1.

Marx, R., de Mello, A. M., Zilbovicius, M., & de Lara, F. F. (2015). Spatial contexts and firm strategies: Applying the multilevel perspective to sustainable urban mobility transitions in Brazil. *Journal of Cleaner Production, 108*, 1092–1104. https://doi.org/10.1016/j.jclepro.2015.09.001.

McFadden, D. (1980). Econometric models for probabilistic choice among products. *Journal of Business, 53*(3), S13–S29. https://doi.org/10.1086/296093.

Mihale-Wilson, A. C., Zibuschka, J., & Hinz, O. (2019). User preferences and willingness to pay for in-vehicle assistance. *Electronic Markets, 29*(1), 37–53. https://doi.org/10.1007/s12525-019-00330-5.

Ministerium für Verkehr Baden-Württemberg (2020). *Echtzeit und intermodale Reiseauskunft*. URL: https://vm.baden-wuerttemberg.de/en/mobilitaet-verkehr/bus-und-bahn/digitalisierung-im-oepnv/echtzeit-und-intermodale-reiseauskunft/. Accessed 18 Apr 2020.

Molin, E. J. E., & Timmermans, H. J. P. (2006). Traveler expectations and willingness-to-pay for web-enabled public transport information services. *Transportation Research Part C: Emerging Technologies, 14*(2), 57–67. https://doi.org/10.1016/j.trc.2006.05.003.

Naous, D., & Legner, C. (2017). *Leveraging market research techniques in IS – A review of conjoint analysis in IS research*. Seoul: International Conference on Information Systems.

Ofungwu, J. (2014). *Statistical applications for environmental analysis and risk assessment*. Hoboken: John Wiley & Sons.

Orme, B. (2015). Including holdout choice tasks in conjoint studies. Sawtooth Software*:* Research Paper Series.

Pronello, C., & Camusso, C. (2015). User requirements for the design of efficient mobile devices to navigate through public transport networks. In N. Thomopoulos, M. Givoni, & P. Rietveld (Eds.), *ICT for transport* (pp. 55–93). Cheltenham: Edward Elgar Publishing.

Pronello, C., Duboz, A., & Rappazzo, V. (2017). Towards smarter urban mobility: Willingness to pay for an advanced traveller information system in Lyon. *Sustainability, 9*(10). https://doi.org/10.3390/su9101690.

QuestionPro (2019). *Choice based conjoint web software*. URL: https://www.questionpro.com/choicebased-conjoint-web-software.html (visited on 14-02-2019).

Rayle, L., Shaheen, S., Chan, N., Dai, D. & Cervero, R. (2014). App-based, on-demand ride services: Comparing taxi and ridesourcing trips and user characteristics in San Francisco.

Roßnagel, H., Zibuschka, J., Hinz, O., & Muntermann, J. (2014). Users' willingness to pay for web identity management systems. *European Journal of Information Systems, 23*(1), 36–50. https://doi.org/10.1057/ejis.2013.33.

Sattler, H., & Hartmann, A. (2008). Commercial use of conjoint analysis. In M. Höck & V. Kai-Ingo (Eds.), *Operations Management in Theorie und Praxis* (pp. 103–119). Wiesbaden: Gabler.

Scheiner, J., & Holz-Rau, C. (2013). Changes in travel mode use after residential relocation: A contribution to mobility biographies. *Transportation, 40*(2), 431–458. https://doi.org/10.1007/s11116-012-9417-6.

Schikofsky, J., Dannewald, T., & Kowald, M. (2020). Exploring motivational mechanisms behind the intention to adopt mobility as a service (Maas): Insights from Germany. *Transportation Research Part A: Policy and Practice, 131*, 296–312. https://doi.org/10.1016/j.tra.2019.09.022.

Schmidt-Rauch, S., & Schwabe, G. (2014). Designing for mobile value co-creation—The case of travel counselling. *Electronic Markets, 24*(1), 5–17. https://doi.org/10.1007/s12525-013-0124-8.

Schreieck, M., Kolbe, F., Pflügler, C., Wiesche, M., & Krcmar, H. (2018a). Monetarisierungsstrategien für Mobilitätsplattformen. In M. Wiesche, P. Sauer, J. Krimmling, & H. Krcmar (Eds.), *Management digitaler Plattformen* (pp. 67–91). Wiesbaden: Springer Gabler.

Schreieck, M., Pflügler, C., Setzke, D. S., Wiesche, M., & Krcmar, H. (2018b). Improving urban transportation: An open platform for digital mobility services. In C. Linnhoff-Popien, R. Schneider, & M. Zaddach (Eds.), *Digital marketplaces unleashed* (pp. 479–489). Berlin: Springer.

Schulz, T., & Überle, M. (2018). *How institutional arrangements impede realization of smart ecosystems: The case of door-to-door mobility integrators*. Portsmouth: European Conference on Information Systems.

Schulz, T., Gewald, H., & Böhm, M. (2018). *The long and winding road to smart integration of door-to-door mobility services: An analysis of the hindering influence of intra-role conflicts*. Portsmouth: European Conference on Information Systems.

Schulz, T., Böhm, M., Gewald, H. & Krcmar, H. (2019). Door-to-door mobility integrators as keystone organizations of smart ecosystems: Resources and value co-creation – A literature review. International Conference on Wirtschaftsinformatik. Siegen. p. 1463-1477

Schulz, T., Böhm, M., Gewald, H., Celik, Z. & Krcmar, H. (2020a). The negative effects of institutional logic multiplicity on service platforms in intermodal mobility ecosystems. *Business & Information Systems Engineering, 62(5)*, 417–433. https://doi.org/10.1007/s12599-020-00654-z

Schulz, T., Gewald, H., Böhm, M. & Krcmar, H. (2020b). Smart mobility: Contradictions in value co-creation. Information Systems Frontiers.

Schwanen, T., & Mokhtarian, P. L. (2005). What affects commute mode choice: Neighborhood physical structure or preferences toward neighborhoods? *Journal of Transport Geography, 13*(1), 83–99. https://doi.org/10.1016/j.jtrangeo.2004.11.001.

Semanjski, I., & Gautama, S. (2016). Crowdsourcing mobility insights – Reflection of attitude based segments on high resolution mobility behaviour data. *Transportation Research Part C: Emerging Technologies, 71*, 434–446. https://doi.org/10.1016/j.trc.2016.08.016.

Shaheen, S., A., Guzman, S. & Zhang, H. (2010). Bikesharing in Europe, the Americas, and Asia. Past, present, and future. *Transportation Research Record: Journal of the Transportation Research Board, 2143(1)*, 159–167. https://doi.org/10.3141/2143-20.

Siren, A., & Haustein, S. (2013). Baby boomers' mobility patterns and preferences: What are the implications for future transport? *Transport Policy, 29*, 136–144. https://doi.org/10.1016/j.tranpol.2013.05.001.

Spohrer, J. C., & Maglio, P. P. (2010). Toward a science of service systems: Value and symbols. In P. P. Maglio, C. A. Kieliszewski, & J. C. Spohrer (Eds.), *Handbook of service science* (pp. 157–194). Boston: Springer.

Statistische Ämter des Bundes und der Länder (2018). *Bevölkerung nach Altersgruppen. Ergebnisse des Zensus 2011*. URL: http://www.statistikportal.de/de/bevoelkerung/ergebnisse-des-zensus-2011/bevoelkerung-nach-altersgruppen. Accessed 15 Apr 2020.

Statistisches Bundesamt (2011). *Großstädte in Deutschland*. URL: https://www.destatis.de/DE/ZahlenFakten/LaenderRegionen/Regionales/Gemeindeverzeichnis/Administrativ/GrosstaedteEinwohner.html. Accessed 27 Dec 2018.

Statistisches Bundesamt (2016). *Verdienstunterschied zwischen Frauen und Männern in Deutschland bei 21%*. URL: https://www.destatis.de/DE/PresseService/Presse/Pressemitteilungen/2016/03/PD16_097_621.html. Accessed 18 Feb 2019.

Statistisches Bundesamt (2018). *Städte (alle Gemeinden mit Stadtrecht). Nach Fläche, Bevölkerung und Bevölkerungsdichte. Am 31.12.2017, Im November 2018 wegen korrigierter Bevölkerung revidiert*. URL: https://www.destatis.de/DE/ZahlenFakten/LaenderRegionen/Regionales/Gemeindeverzeichnis/Administrativ/Aktuell/05Staedte.html. Accessed 27 Dec 2018.

Statistisches Bundesamt (2019). *VGR des Bundes - Arbeitnehmerentgelt, Löhne und Gehälter*. URL: https://www-genesis.destatis.de/genesis/online. Accessed 18 Feb 2019.

Stopka, U. (2014). *Identification of user requirements for mobile applications to support door-to-door mobility in public transport*. Heraklion: International Conference on Human-Computer Interaction.

Storbacka, K., Brodie, R. J., Böhmann, T., Maglio, P. P., & Nenonen, S. (2016). Actor engagement as a microfoundation for value co-creation. *Journal of Business Research, 69*(8), 3008–3017. https://doi.org/10.1016/j.jbusres.2016.02.034.

Tautz, D. (2017). *So viel gependelt wurde noch nie*. URL: https://www.zeit.de/mobilitaet/2017-07/pendler-rekord-arbeitnehmer-stress. Accessed 16 Feb 2019.

Teubner, T., & Flath, C. M. (2015). The economics of multi-hop ride sharing. Creating new mobility networks through IS. *Business & Information Systems Engineering, 57*(5), 311–324. https://doi.org/10.1007/s12599-015-0396-y.

Tuominen, A., Järvi, T., Räsänen, J., Sirkiä, A., & Himanen, V. (2007). Common preferences of different user segments as basis for intelligent transport system: Case study – Finland. *IET Intelligent Transport Systems, 1*(2), 59–68. https://doi.org/10.1049/iet-its:20060065.

Turetken, O., Grefen, P., Gilsing, R., & Adali, O. E. (2019). Service-dominant business model design for digital innovation in smart mobility. *Business & Information Systems Engineering, 61*(1), 9–29. https://doi.org/10.1007/s12599-018-0565-x.

Umweltbundesamt (2019). Veränderungen im Mobilitätsverhalten zur Förderung einer nachhaltigen Mobilität.

United Nations Department of Economic and Social Affairs (2015). World Urbanization Prospects.

Vargo, S. L., & Lusch, R. F. (2004). Evolving to a new dominant logic for marketing. *Journal of Marketing, 68*(1), 1–17. https://doi.org/10.1509/jmkg.68.1.1.24036.

Vargo, S. L., & Lusch, R. F. (2016). Institutions and axioms: An extension and update of service-dominant logic. *Journal of the Academy of Marketing Science, 44*(1), 5–23. https://doi.org/10.1007/s11747-015-0456-3.

Vargo, S. L., & Lusch, R. F. (2017). Service-dominant logic 2025. *International Journal of Research in Marketing, 34*(1), 46–67.

Vargo, S. L., Maglio, P. P., & Akaka, M. A. (2008). On value and value co-creation: A service systems and service logic perspective. *European Management Journal, 26*(3), 145–152. https://doi.org/10.1016/j.emj.2008.04.003.

Vargo, S. L., Wieland, H., & Akaka, M. A. (2015). Innovation through institutionalization: A service ecosystems perspective. *Industrial Marketing Management, 44*, 63–72. https://doi.org/10.1016/j.indmarman.2014.10.008.

Wang, Q. E., Myers, M. D., & Sundaram, D. (2013). Digital natives and digital immigrants: Towards a model of digital fluency. *Business & Information Systems Engineering, 5*(6), 409–419. https://doi.org/10.1007/s12599-013-0296-y.

Willing, C., Brandt, T., & Neumann, D. (2017a). Electronic mobility market platforms – A review of the current state and applications of business analytics. *Electronic Markets, 27*(3), 267–282. https://doi.org/10.1007/s12525-017-0257-2.

Willing, C., Brandt, T., & Neumann, D. (2017b). Intermodal mobility. *Business & Information Systems Engineering, 59*(3), 173–179. https://doi.org/10.1007/s12599-017-0471-7.

Wlömert, N., & Eggers, F. (2016). Predicting new service adoption with conjoint analysis: External validity of BDM-based incentive-aligned and dual-response choice designs. *Marketing Letters, 27*(1), 195–210. https://doi.org/10.1007/s11002-014-9326-x.

Xiao, G., Juan, Z., & Zhang, C. (2016). Detecting trip purposes from smartphone-based travel surveys with artificial neural networks and particle swarm optimization. *Transportation Research Part C: Emerging Technologies, 71*, 447–463. https://doi.org/10.1016/j.trc.2016.08.008.

Yadav, P., Hasan, S., Ojo, A., & Curry, E. (2017). *The role of open data in driving sustainable mobility in nine smart cities*. Guimarães: European Conference on Information Systems.

Zografos, K. G., Androutsopoulos, K. N., & Apospori, E. (2012). User acceptance and willingness to pay for the use of multimodal trip planning systems. *Procedia - Social and Behavioral Sciences, 48*, 2405–2414. https://doi.org/10.1016/j.sbspro.2012.06.1211.

Appendix C. Supplementary Material: Smart Mobility – An Analysis of Potential Customers' Preference Structures (P2)

Supplementary material

In the following, we provide supplementary information about the value model and the choice model on which our data analysis is based. In addition, detailed insights are given into the estimation of the part-worths. The explanations are based on Backhaus et al. (2015).

Specification of the value model

In order to be able to explain the choice decisions of participants, initially a value model must be specified. The value model indicates the relation between the presence of a specific attribute level of an attribute and the value which is created for customers. If qualitative attributes, such as 'type of company' and 'booking', are present in the CBC analysis, the (additive) *part-worth model* is to be applied. This can be represented mathematically:

$$u_{kr} = \sum_{j=1}^{J} \sum_{m=1}^{M_j} b_{jm} * x_{jmkr} \qquad (k = 1, ..., K ; r = 1, ..., T)$$

u_{kr} = (Total) value of the alternative k in the choice situation r

b_{jm} = Part-worth for the attribute level m of the attribute j

x_{jmkr} = 1, if the alternative k in the choice situation r with regard to the attribute j has the attribute level m, and otherwise 0

In each choice situation, participants have four alternatives to choose from – three different smart mobility apps and the alternative 'none of the options' (see Figure 2). If only one choice situation is considered, the index r can be omitted.

Specification of the choice model

In the case of CBC analysis, the data collection consists of the recording of the choice decisions of participants. For that reason, a choice model is needed which can explain how participants decide for one of the presented alternatives on the basis of the total value. The choice model that is most frequently used in CBC analysis is the (multinominal) *logit choice model*:

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$$\text{prob}_i(k\text{I}k' \in CS) = \frac{e^{\beta_i * u_{ik}}}{\sum_{k \in CS} e^{\beta_i * u_{ik}}} = \frac{1}{1 + \sum_{k' \neq k \in CS} e^{-\beta_i * [u_{ik} - u_{ik'}]}}$$

i = Person

$\text{prob}_i(k)$ = Probability for the choice of the alternative k (k = 1, 2, …, K) among K alternatives

u_{ik} = (Total) value for the alternative k (k = 1, 2, …, K)

$\beta_i \geq 0$ (rationality parameter)

Estimation of the part-worths

The logit choice model can be described as function:

$$\text{prob}(k) = f_c(u_1, \dots, u_K) \qquad \text{(k = 1, ..., K)}$$

with $$u_k = f_u \{b_{jm}\}_{j=1,\dots,J;\ m=1,\dots,M_j} \qquad \text{(Value model)}$$

The part-worths b_{jm} are to be estimated. However, the variable prob(k) is not observable, and thus no data is available for it. Instead, we have information about the choice decisions of the potential customers. These data have a nominal scale level, which makes the use of regression analysis or of the method of ordinary least squares not possible. For this reason, the maximum-likelihood method is used for the estimation of the part-worths. Thereby, the part-worths are estimated in such a way that the observed choice decisions of the participants can be explained as plausibly as possible. This is the case when the probability for the each chosen alternative k becomes as high as possible in a certain choice situation r. This should apply to all R choice situations. Based on this, the following likelihood function can be formulated, which is to be maximized:

$$L = \prod_{r=1}^{R} \prod_{k=1}^{K} \text{prob}_r(k)^{d_{kr}} \rightarrow \text{Max!}$$

with d_{kr} = 1, if in the choice situation r alternative k is chosen, otherwise 0

For the calculation, it is advantageous to logarithmize the probabilities:

$$LL = \sum_{r=1}^{R}\sum_{k=1}^{K} \ln[prob_r(k)] * d_{kr} \rightarrow Max!$$

The maximization of both functions leads to the same result, because the logarithm is a strictly monotonously increasing function. Usually, there are not enough data in the case of CBC analysis to conduct the estimation for a single participant. Therefore, the data of several or all participants are merged, resulting in T = I * R choice decisions. The *estimation problem* of the CBC analysis can thus be summarized as follows:

$$LL = \sum_{r=1}^{T}\sum_{k=1}^{K} \ln[prob_r(k)] * d_{kr} \rightarrow Max!$$

with

$$prob_r(k) = \frac{e^{u_{kr}}}{\sum_{k' \in CS_r} e^{u_{k'r}}} \qquad \text{(Choice model)}$$

$$u_{kr} = \sum_{j=1}^{J} \sum_{m=1}^{M_j} b_{jm} * x_{jmkr} \qquad \text{(Value model)}$$

The part-worths are to be estimated in such a way that LL is maximized. For the solution of this optimization problem iterative algorithms must be applied. Thereby, it can be chosen between the quasi-Newton procedure and the gradient method.

The effect of age on the preference structure

Quality criterion	**Group 5: Public transport ≥ 25 years old** (n = 46)	**Group 6: Private car ≥ 25 years old** (n = 49)
P-value	0.00	0.00
Hit rate	41.30	46.43

Table 11. Quality criteria for Cox regression analysis (in %).

Attribute	**Group 5: Public transport ≥ 25 years old** (n = 46)	**Group 6: Private car ≥ 25 years old** (n = 49)
Type of company	5.65	4.44
Share of companies	14.17	20.57
Time-table information	19.66	26.34
Booking	25.16	22.50
Price model	6.74	5.64
App price	28.62	20.52

Table 12. Relative importance of attributes (in %).

Attribute level	**Group 5: Public transport ≥ 25 years old** (n = 46)			**Group 6: Private car ≥ 25 years old** (n = 49)		
	Part-worths	*SD*	*Mean difference compared to Group 3*	*Part-worths*	*SD*	*Mean difference compared to Group 4*
Public transport + Bike-sharing + Car-sharing	0.008	0.146	-0.007	-0.099	0.133	-0.017
All	0.128	0.143	0.233	-0.106	0.137	-0.370
33-66%	0.322**	0.147	0.046*	0.314**	0.149	0.149
> 66%	0.302**	0.149	-0.178***	0.491***	0.141	0.137***
Mixed information	0.329**	0.154	-0.196***	0.417***	0.152	-0.024
Real-time information	0.447***	0.148	-0.175***	0.629***	0.140	-0.038
Forwarding to the website	0.279*	0.154	0.078***	0.150	0.149	-0.093
One-click booking	0.571***	0.145	0.151***	0.537***	0.136	0.131***
Dynamic price	-0.029	0.141	0.018	-0.123	0.133	0.079
Monthly flat-rate	-0.153	0.145	-0.198	-0.135	0.135	-0.185
3 Euro	-0.375***	0.135	0.297***	-0.287**	0.131	0.090**
5 Euro	-0.650***	0.144	0.374***	-0.490***	0.138	-0.054
None	0.021	0.262	0.501	-0.043	0.252	0.223

Table 13. Part-worths for attribute levels ($p < 0.10$; **$p < 0.05$; ***$p < 0.01$).*

The effect of place of residence on the preference structure

Mix

Quality criterion	**Group 4: Mix Rural area** (n = 25)
P-value	0.00
Hit rate	45.00

Table 14. Quality criteria for Cox regression analysis (in %).

Attribute	**Group 4: Mix Rural area** (n = 25)
Type of company	12.07
Share of companies	23.90
Time-table information	13.91
Booking	9.24
Price model	15.11
App price	25.76

Table 15. Relative importance of attributes (in %).

Attribute level	**Group 4: Mix Rural area** (n = 25)		
	Part-worths	*SD*	*Mean difference compared to Group 2*[1]
Public transport + Bike-sharing + Car-sharing	0.173	0.208	0.004
All	0.336	0.206	-0.127
33-66%	0.415*	0.219	0.011
> 66%	0.665***	0.207	0.187***
Mixed information	0.367*	0.204	0.101***
Real-time information	0.387*	0.210	-0.167
Forwarding to the website	0.129	0.199	-0.046
One-click booking	0.257	0.196	-0.091

Dynamic price	0.244	0.189	0.379
Monthly flat-rate	-0.176	0.210	-0.061
3 Euro	-0.379**	0.186	0.174***
5 Euro	-0.716***	0.206	0.109
None	0.402	0.349	0.493

*Table 16. Part-worths for attribute levels (*p < 0.10; **p < 0.05; ***p < 0.01).*

[1] Mann-Whitney U test

Private car

Quality criterion	**Group 5: Private car Big city** (n = 10)	**Group 6: Private car Town** (n = 39)
P-value	0.26	0.00
Hit rate	50.00	47.44

Table 17. Quality criteria for Cox regression analysis (in %).

Attribute	**Group 5: Private car Big city** (n = 10)	**Group 6: Private car Town** (n = 39)
Type of company	26.38	10.42
Share of companies	18.34	20.21
Time-table information	12.21	32.21
Booking	22.19	16.17
Price model	19.17	1.94
App price	1.71	19.06

Table 18. Relative importance of attributes (in %).

Attribute level	**Group 5: Private car Big city** (n = 10)			**Group 6: Private car Town** (n = 39)		
	Part-worths	*SD*	*Mean difference compared to Group 6*[1]	*Part-worths*	*SD*	*Mean difference compared to Group 3*
Public transport + Bike-sharing + Car-sharing	-0.543*	0.323	-0.463	-0.080	0.153	0.106
All	-0.711**	0.334	-0.867	0.156	0.150	0.023
33-66%	0.494	0.345	0.427	0.067	0.163	0.311

> 66%	0.474	0.344	0.016	0.458***	0.155	-0.070*
Mixed information	0.329	0.361	-0.069	0.398**	0.166	0.090**
Real-time information	0.232	0.346	-0.498	0.730***	0.154	-0.038
Forwarding to the website	0.228	0.355	0.190	0.038	0.158	0.399
One-click booking	0.598*	0.335	0.231***	0.367**	0.144	0.320***
Dynamic price	-0.516*	0.313	-0.514	-0.002	0.150	-0.220
Monthly flat-rate	-0.466	0.341	-0.508	0.042	0.151	-0.076
3 Euro	-0.046	0.330	0.321	-0.367**	0.143	-0.022
5 Euro	-0.006	0.329	0.426	-0.432***	0.152	-0.188***
None	0.198	0.550	0.557	-0.359	0.282	0.437

*Table 19. Part-worths for attribute levels (*p < 0.10; **p < 0.05; ***p < 0.01).*

[1] Mann-Whitney U test

Public transport

Quality criterion	**Group 7: Public transport Big city** (n = 68)	**Group 8: Public transport Town** (n = 57)	**Group 9: Public transport Rural area** (n = 17)
P-value	0.00	0.00	0.00
Hit rate	47.79	50.00	55.15

Table 20. Quality criteria for Cox regression analysis (in %).

Attribute	**Group 7: Public transport Big city** (n = 68)	**Group 8: Public transport Town** (n = 57)	**Group 9: Public transport Rural area** (n = 17)
Type of company	2.39	2.60	7.93
Share of companies	12.19	24.86	14.76
Time-table information	30.61	17.61	16.53
Booking	21.81	10.92	21.16
Price model	1.31	4.48	13.41
App price	31.69	39.52	26.21

Table 21. Relative importance of attributes (in %).

Attribute level	Group 7: Public transport Big city (n = 68)		Group 8: Public transport Town (n = 57)			Group 9: Public transport Rural area (n = 17)		
	Part-worths	*SD*	*Part-worths*	*SD*	*Mean difference compared to Group 7*	*Part-worths*	*SD*	*Mean difference compared to Group 8*[1]
Public transport + Bike-sharing + Car-sharing	0.063	0.115	-0.066	0.123	-0.128	0.003	0.230	-0.068
All	0.022	0.114	-0.031	0.125	-0.054	-0.239	0.232	0.208
33-66%	0.320***	0.115	0.340**	0.138	0.020	0.159	0.246	0.181
> 66%	0.276**	0.119	0.626***	0.131	0.350***	0.451*	0.233	0.175***
Mixed information	0.542***	0.129	0.443***	0.128	-0.099***	0.354	0.245	0.089
Real-time information	0.803***	0.123	0.324**	0.131	-0.479***	0.505**	0.233	-0.181***
Forwarding to the website	0.247**	0.122	0.150	0.132	-0.097	0.330	0.248	-0.180
One-click booking	0.572***	0.115	0.275**	0.126	-0.297***	0.646***	0.237	-0.371***
Dynamic price	-0.018	0.117	-0.078	0.124	-0.059	-0.130	0.217	0.052
Monthly flat-rate	0.016	0.113	0.035	0.123	0.019	-0.409*	0.241	0.445
3 Euro	-0.602***	0.109	-0.612***	0.118	-0.011	-0.293	0.220	-0.320
5 Euro	-0.831***	0.122	-0.995***	0.135	-0.163***	-0.800***	0.234	-0.194***
None	-0.061	0.215	-0.458**	0.231	-0.397	-0.684	0.444	0.227

*Table 22. Part-worths for attribute levels (*p < 0.10; **p < 0.05; ***p < 0.01).*

[1] Mann-Whitney U test

References

Backhaus, K., Erichson, B., & Weiber, R. (2015). *Fortgeschrittene Multivariate Analysemethoden: Eine anwendungsorientierte Einführung*. Berlin: Springer Gabler.

Appendix D. The Long and Winding Road to Smart Integration of Door-to-Door Mobility Services: An Analysis of the Hindering Influence of Intra-Role Conflicts (P3)

THE LONG AND WINDING ROAD TO SMART INTEGRATION OF DOOR-TO-DOOR MOBILITY SERVICES: AN ANALYSIS OF THE HINDERING INFLUENCE OF INTRA-ROLE CONFLICTS

Research paper

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Abstract

Technical advances such as sensors and open data have enabled service integrators to offer smarter service packages. Door-to-door (D2D) mobility integrators now promise to provide smart (i.e., highly individualized, dynamic, and context-aware) services by packaging component mobility services provided by independent mobility providers, such as bus, car-sharing and train companies. However, this business model has inherent conflicts.

This research proposes a role framework for smart D2D mobility integrators and analyses intra-role conflicts to explain the low cooperation rate among public transport companies with D2D mobility integrators. Drawing on intermediary literature and role conflict theory, this study identifies how intra-role conflicts between D2D mobility integrators and transport and tariff associations (TTAs), the regional representations of public transport companies, lead to non-cooperation.

Our empirical results from the German mobility sector show strong intra-role conflicts within the logistical and customization role. Especially the TTAs' desire to provide D2D mobility themselves negatively influence their willingness to cooperate.

Keywords: Business Model, Intermediary, Mobility Service, Smart.

1 Introduction

The continuous rise of the Internet over the past 25 years has caused dramatic changes in the travel sector. Several new service integrators acting as intermediaries, such as Expedia and Opodo, use up-to-date technology to empower customers to book their travel without consulting a physical travel agent (Standing et al., 2014; Xiang et al., 2015). In classical travel itineraries, a number of different services need to be combined (flight and hotel, etc.) to meet customer needs. However, compared with door-to-door (D2D) mobility – a new global trend (Consulting4Drive and BSL Transportation Consultants, 2015) – the complexity of such a travel trip is manageable.

D2D mobility refers to individually arranged transport service from a defined starting-point to a defined end-point using different component mobility services, which are provided by independent mobility providers, such as bus, car-sharing, or train companies (Winter et al., 2012). Although D2D mobility services are expected to dominate the mobility market by 2020 (Consulting4Drive and BSL Transportation Consultants, 2015), they are currently not as easy to book as classical travel. In the absence of D2D mobility integrators, customers need to gather all relevant information about the variety of component mobility services on their own, which results in high search costs (Allen and Wu, 2010). This is one reason why people often use their private car, with significant negative effects like air and noise pollution (Barth and Boriboonsomsin, 2008), instead of a more sustainable combination of component mobility services (e.g., riding a rental bike and taking a train). Recently, D2D mobility integrators like Moovel and Qixxit have entered to field to address these shortcomings by offering D2D mobility without the high cost of searching through myriad alternatives (Willing et al., 2017a; 2017b).

However, integrating component mobility services and creating seamless D2D mobility is a complex endeavor. D2D trips are highly dynamic and need to react immediately to disruptions (Gogos and Letellier, 2016; Motta et al., 2013). In order to provide such on-trip services, D2D mobility integrators require access to real-time data such as cancellations or delays on local busses, subways, trains, etc. in the geographic location of the customer, which mobility providers are often unable or reluctant to provide. However, mobility providers and D2D mobility integrators can only provide smart D2D mobility by leveraging sensors, open data and new forms of connectivity and information exchange.

D2D mobility integrators like Moovel and Qixxit, which strive to offer smart D2D mobility (Willing et al., 2017a; 2017b), still struggle to motivate mobility providers to cooperate. In a recent study, Albrecht and Ehmke (2016) find that D2D mobility integrators are currently rarely able to integrate public transport services into D2D trips. The purpose of this paper is to facilitate the expansion of D2D mobility by adopting a mobility provider perspective. We presume that intra-role conflicts caused by incompatible requirements and expectations are the reason mobility providers do not cooperate with D2D mobility integrators and thus a cause of the limited efficiency and context-awareness of D2D mobility (de Reuver et al., 2009; Koch and Schultze, 2011; Subberwal, 2009). To investigate how intra-role conflicts enhance our understanding about the difficulties associated with D2D mobility, we put forth the following research question: *How do intra-role conflicts impede the ability of German D2D mobility integrators to offer D2D mobility comprehensively?*

We conducted interviews with twelve German TTAs (regional representations of public transport companies) which currently do not cooperate with D2D mobility integrators. We chose non-cooperators to find out which intra-role conflicts are factors leading to non-cooperation and thus limit D2D mobility integrators' ability to offer comprehensive smart D2D mobility.

The paper is structured as follows. After reviewing relevant literature focusing on evolving D2D mobility integrators and introducing role conflict theory, we discuss our research methodology and provide background on data collection and analysis. After presenting our results, we discuss their theoretical and practical implications, the limitations of our study, and opportunities for further research.

2 Theoretical Background

An intermediary is defined as an actor who links two or more other actors who do not have a direct relationship (Giaglis et al., 2002). D2D mobility integrators act as intermediaries in that they integrate a variety of component mobility services offered by different mobility providers to create individual end-to-end transport services for their customers. In other words, they act as boundary spanners between mobility providers and customers (Leifer and Delbecq, 1978; Noble and Jones, 2006). This section first traces the evolution of intermediaries from traditional intermediaries (e.g., financial brokers, insurance brokers and wholesalers) to electronic commerce intermediaries (Alibaba, eBay, etc.), service integrators (e.g., Expedia and Opodo) and, ultimately, to smart integrators (e.g., D2D mobility integrators like Moovel and Qixxit). We then derive the roles of D2D mobility integrators from prior literature on electronic commerce intermediaries and introduce role conflict theory along with our initial assumptions about the role conflicts mobility providers may face.

2.1 The Evolution of Intermediaries

With the advent of the Internet and electronic commerce, a lively scientific discussion of the demise of traditional intermediaries (Berger and Gleisner, 2009; Sen and King, 2003; Tay and Chelliah, 2011, etc.), and the opportunities for new electronic commerce intermediaries, so-called '*e-intermediaries*' (e.g., Anderson and Anderson, 2002; Barnes and Hinton, 2007; Brousseau, 2002; Giaglis et al., 2002; Sarkar et al., 1995), ensued. In the past ten years, a variety of examples like Alibaba, Charles Schwab, eBay, and Marsh & McLennan have shown how advancements in information technology (IT) and customer demands contribute to the economic importance of e-intermediaries.

Recognizing that customer needs are not atomistic (Alt, 2016) and that a single company is rarely able to fulfill all of a customer's needs, several studies have investigated the collaboration of service providers (see e.g., Baumöl and Winter, 2001; Heinrich et al., 2011). Across various theoretical perspectives (Alt, 2016; Heinonen and Strandvik, 2015; Lusch and Nambisan, 2015), there is a broad consensus on the need for intermediaries able to coordinate existing service providers effectively and provide a unitary service to the customer.

The relevant literature has different terms for such intermediaries, including 'aggregators' (Baumöl and Winter, 2001), 'composition intermediaries' (Schulz et al., 2016), 'orchestrators' (van Liere et al., 2010), or 'service integrators' (Heinrich et al., 2011). In this paper, we use the term '*service integrator'*. According to Heinrich and Winter (2004, p. 4), "service integrators support complex end-consumer processes by aggregating reusable as well as specific service components". Travel agencies like Expedia and Opodo, for example, compile flight, hotel and rental car service into an individual service package.

Technical progress (access to data, sensors, etc.) will increasingly enable service integrators to become '*smart integrators'* that offer individual, context-aware and dynamic service packages. Smart D2D mobility integrators, for instance, will automatically reschedule or rebook individual component mobility services in reaction to unforeseen events on a trip (Gogos and Letellier, 2016; Motta et al., 2013). Analogous to concepts like 'smart home' (Rocznik et al., 2017), 'smart cities' or 'smart tourism' (Gretzel et al., 2015), smart D2D mobility can thus be defined as context-aware and dynamic service enabled by advanced IT. Services such as Google Maps™ already rely on such advanced IT to predict car traffic flow (Lu et al., 2011), which depends on influencing factors like time of the day, day of the week, and special events including accidents. Google Maps™ also provides real-time public transport information for a continuously growing number of countries and cities (Shalaik and Winstanley, 2011), making it possible to take cancellations into account. Another example is Uber's pricing model. Uber uses advanced IT to apply dynamic pricing methods to capitalize on demand increases in the case of big sporting events, holidays or inclement weather (Chen et al., 2015).

The evolution of intermediaries indicates that the expectations of and requirements placed on intermediaries, including their role and associated tasks, fluctuate over time. Presumably, D2D mobility integrators also have to fulfill specific roles in order to be able to provide D2D mobility.

2.2 Roles of D2D Mobility Integrators

Our review of relevant literature finds no discussion of the roles of smart integrators, but several role frameworks for e-intermediaries have been proposed (e.g., Anderson and Anderson, 2002; Bakos, 1998; Brousseau, 2002; Giaglis et al., 2002; Sarkar et al., 1995). The role framework proposed by Barnes and Hinton (2007) synthesizes previous approaches, identifying five roles that e-intermediaries are expected to fulfill. The following section discusses how these roles need to be reframed for D2D mobility integrators.

The **informational role** of a D2D mobility integrator is to provide detailed information about customers (e.g., trip date, number of passengers), mobility providers as well as their component mobility services. In particular, the D2D mobility integrator needs to provide superordinate information (Ehmke et al., 2016; Willing et al., 2017a), providing customers with D2D trip data (transfers, trip duration, etc.) and information about integrated component mobility services (e.g., mobility provider name, departure and arrival point).

A D2D mobility integrator taking the **transactional role** enables one-stop purchases of D2D mobility and settles payments with mobility providers (Gogos and Letellier, 2016; Willing et al., 2017a; 2017b). As in the travel sector, they are embedded and can offer a price advantage over individual bookings. Several D2D mobility integrators do not currently fulfill this role (Albrecht and Ehmke, 2016), but instead forward the customer to individual mobility providers.

When acting in the **assurance role**, D2D mobility integrators have to ensure that a customer will receive the high quality D2D mobility they expect. In part, D2D mobility integrators automatically propose an alternative D2D trip if a component mobility service drops out (e.g., in the case of a delay) (Gogos and Letellier, 2016; Motta et al., 2013; Willing et al., 2017b). However, currently, D2D mobility integrators do not mediate between a customer and a mobility provider in cases when the expected quality is not provided (dirty seats, unfriendly drivers, etc.). Nevertheless, they ensure a specific kind of initial quality by screening mobility providers before cooperating with them. In addition, D2D mobility integrators have assure mobility providers that they will receive payment.

The **logistical role** of a D2D mobility integrator involves the continuous delivery of information to support a customer during the D2D trip and make adjustments in cases of unforeseen events. In order to enable seamless D2D mobility, also the provision of information about integrated self-services (e.g., how to walk from the train station to the bus stop) is necessary. Besides the supply of information, the logistical role includes, in particular, the delivery of service credentials such as tickets and reservations (Albrecht and Ehmke, 2016). Overall, the consecutive dependence on component mobility services distinguishes the logistical role of an e-intermediary from the logistical role of a D2D mobility integrator.

Within their **customization role**, D2D mobility integrators tailor D2D mobility to better meet customers' needs. Individualized D2D mobility is, by nature, customized because it consists of several component mobility services (Boero et al., 2016; Motta et al., 2013). A more advanced customization role is when D2D mobility integrators enable customers to specify the component mobility services before/after they are selected, for example, personalize their walking speed data, or prioritize taxi drivers with whom they were satisfied in the past.

In order to provide D2D mobility efficiently, D2D mobility integrators must thus perform the five roles described above. However, since mobility providers such as public transport companies may have conflicting role expectations, conflicts may arise as D2D mobility providers attempt to perform these roles. We turn to role conflict theory to better understand these conflicts, their origins and their effects.

2.3 Role Conflict Theory

Role conflict theory shows that when an actor performs one or more roles, "there is always a *potential* for differing and sometimes conflicting expectations of the conduct appropriate to a status-occupant [i.e., actor performing the roles]" (Merton, 1957, p. 112). Role expectations represent attitudes, beliefs, and norms with regard to a social position (e.g., a physician should wear a white coat) or a context (e.g., an audience should be quiet during an opera performance) (Biddle, 1979; Koch and Schultze, 2011). Perrone et al. (2003) argue that expectations also include goals and values assigned to a role.

A role conflict can be segregated into 'inter-role conflict' and 'intra-role conflict' (Subberwal, 2009). Whereas the former refers to conflicting expectations associated with multiple roles performed by one actor, for example, a D2D mobility integrator may perceived contradictory expectations concerning its transactional and logistical role, the latter describes a situation in which different actors (e.g., customers or mobility providers) have conflicting expectations of a focal role (D2D mobility integrator) (Merton, 1957). As a consequence, intra-role conflicts arise "when there is a lack of understanding about roles or they are mismanaged" (Subberwal, 2009, R11). In the past, role conflict theory was used in varying research fields (business administration, information systems, sociology, etc.) as well as at an individual (e.g., Allen et al., 2000; Allison, 1991; Sage and Loudermilk, 1979), group (e.g., Arumugam, 2013; Koch et al., 2014), and organizational level of analysis. In the following, we focus on studies at the organizational level.

At the organizational level, actors represent cooperating companies. The work of de Reuver et al. (2009) highlights the crucial importance of an acceptable division of roles, as perceived by the companies involved, for the success of a business model. A number of authors (e.g., Bengtsson and Kock, 2015; Dowling et al., 1996) further emphasize that cooperation simultaneously involves competition (referred as 'coopetition'). Walley (2007, p. 16) argues that "this requires firms to adopt conflicting roles". When role conflicts are not managed, they can limit interorganizational knowledge sharing and learning (Chowdhury et al., 2016; Walley, 2007), increase uncertainty, reduce stability, as well as cause costs for cooperating companies (Dowling et al., 1996). In terms of managing role conflicts, Bengtsson and Kock (2015) point out the high importance of role clarity and role stability.

In contrast, Havila (1992) explicitly focuses on intermediary companies in a triadic business relationship, illustrating that in three of four possible situations either the expectations of the supplier and/or the customer company are in conflict with those of the intermediary, which limits the intermediary's ability to perform its role. Koch and Schultze (2011, p. 123) use role conflict theory to analyze business-to-business electronic marketplaces (i.e., intermediaries) as the "conflicted middle" between market and hierarchy. Their results show that all companies involved, i.e., the intermediary as well as the buyers and suppliers, have their own role expectations leading to goal, behavior, and identity conflicts.

Concerning D2D mobility integrators, an intra-role conflict may concern the transactional role. For instance, de Reuver et al. (2009, p. 6) state that "both content providers and operators [i.e., mobility providers and D2D mobility integrators] will be interested in owning the customer, because billing customers provides advantages of additional revenues".

2.4 Summary and Initial Assumptions

D2D mobility integrators try to offer D2D mobility by integrating different component mobility services which are provided by independent mobility providers, such as bus, car-sharing, and train companies. Providing such D2D mobility implies expectations about the five underlying roles D2D mobility integrators need to fulfil, as depicted in Figure 1.

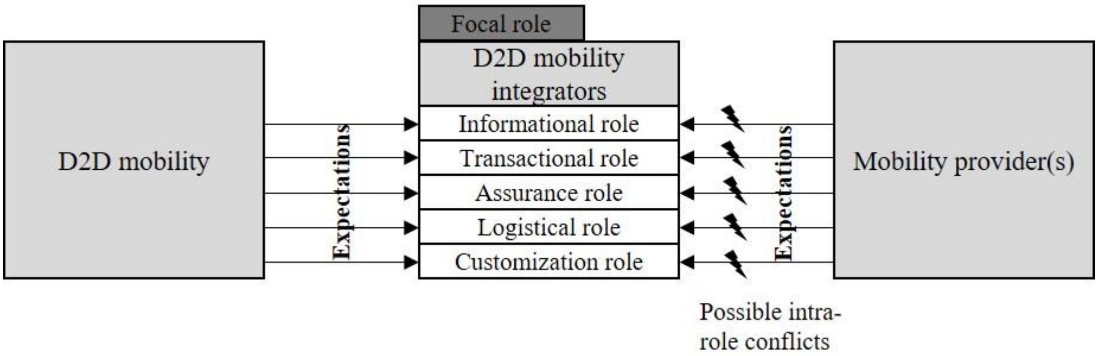

Figure 1. Intra-role conflicts stemming from diverging D2D mobility integrator role expectations.

Although D2D mobility is expected to be increasingly important (Consulting4Drive and BSL Transportation Consultants, 2015) and technical progress is paving the way for such smart services, D2D mobility integrators are often unable to fulfill the described roles. Ehmke et al. (2016), for instance, analyzed D2D mobility integrators in the German-speaking area and show that only nearly half of the D2D mobility integrators take dynamic customer data into account. Moreover, customers usually get separate invoices for each component mobility service which is included in a D2D mobility service package and are not able to modify these packages after purchase.

In this paper, we assume that these shortcomings may be caused by intra-role conflicts. Due to the intermediary position of D2D mobility integrators, there is a high probability that independent mobility providers have varying role expectations. More specifically, we argue that the underlying reasons for these intra-role conflicts are (a) general rejection of an intermediary position in the case of some of the roles of D2D mobility integrators, and/or (b) the current inability of D2D mobility integrators to act smart in these roles.

Although studies at the organizational level have demonstrated the strong impact of intra-role conflicts on cooperation between companies, there have been no such examinations of the relationship between intra-role conflicts and the cooperative behavior of mobility providers. We assume that the low degree of cooperation between mobility providers and D2D mobility integrators (Albrecht and Ehmke, 2016) is due to such intra-role conflicts.

3 Methodology

3.1 Research Context

As laid out above, the mobility sector is in a state of flux fuelled by technical progress (Münchner Kreis e.V., 2017). In recent years, different publicly funded projects such as the Intermodal Mobility Assistance for Megacities (Masuch et al., 2013), Mobility Broker (Beutel et al., 2014a; 2014b), and WISETRIP (Aditjandra et al., 2009) were initiated to offer D2D mobility by integrating different component mobility services. However, these projects have still not been implemented or have already been discontinued (Willing et al., 2017b). Simultaneously, numerous private companies emerged which try to act as D2D mobility integrators. An overview for the German-speaking area is offered by Albrecht and Ehmke (2016) and Willing et al. (2017a; 2017b). The most prominent examples are Moovel (founded by Daimler AG in 2012) and Qixxit (a subsidiary of Deutsche Bahn AG, in operation since

2013). All of these D2D mobility integrators are currently still in the start-up phase, attempting to find a sustainable business model (Willing et al., 2017a). Especially motivating a large number of mobility providers to cooperate, in order to be able to offer alternative D2D trips, seems to be the major challenge. Schulz and Überle (2018) identify different existing institutional arrangements in which mobility providers, such as car- and bike-sharing companies, are embedded that impede cooperation with D2D mobility integrators. Similarly, the results of Albrecht and Ehmke (2016) showed that, for example, only 44% of D2D mobility integrators in German-speaking Europe are able to integrate public transport services.

German public transport is well-suited for studying intra-role conflicts for several reasons. First, public transport in Germany mainly is organized locally by so-called 'transport and tariff associations' (TTAs). While in the past the vast majority of TTAs consisted solely of independent transport companies (bus, subway, tram, and/or train), more recently regional authorities like federal states, districts, or cities act as (additional) shareholders (Reinhardt, 2012). Due to this organization structure, non-cooperation of TTAs causes a relatively large local blank spot on the map of D2D mobility integrators.

Second, German public transport companies are often considered less innovative than private transport companies (Monheim and Schroll, 2005). Hence, we would expect a high number of intra-role conflicts concerning cooperation with emerging D2D mobility integrators. On the other hand, in comparison with other regions of the world, the pre-existing infrastructure, a great public pressure, as well as institutional and legal conditions lead to the D2D mobility concept being more advanced in Europe, especially Germany (Marx et al., 2015; Willing et al., 2017b). Accordingly, German TTAs should be sufficiently familiar with the topic to answer our questions.

Third, a number of indicators emphasize the importance of public transport for the German population and authorities. In 2015, more than 10 billion rides were taken on German public transport systems. Nonetheless, the transport companies generated an overall loss of 3 billion euros (in 2014), a cost recovery ratio of 77% (Verband Deutscher Verkehrsunternehmen, 2016). As a result, regional authorities are often forced to provide financial support (financing of the mobility service, train funding, etc.) to guarantee public transport (Reinhardt, 2012).

Fourth, according to Watson et al. (2011) the mobility sector is one of the main sources of greenhouse gases, and subsequently a critical factor in global climate change. An understanding of intra-role conflicts inhibiting cooperation on behalf of public transport is especially useful because otherwise D2D mobility is greatly restricted to relatively high carbon emittance individual transport (e.g., car-sharing, taxi).

3.2 Data Collection and Analysis

In 2016, there were approximately 124 German TTAs (Reinhardt, 2012; Wikipedia, 2016). We used a theoretical sampling method (Flick, 2009; Glaser and Strauss, 1967) to select 45 TTAs in total that are typical with regard to the number of involved public transport companies and passengers they transport per year. The managing director (MD) of each TTA was chosen as contact person since s/he is responsible for strategic decisions such as a business cooperation with D2D mobility integrators. Furthermore, a snowball sampling (e.g., Su, 2013) was used to identify additional experts (project managers – PM, etc.). Overall, we received twelve interview confirmations from TTAs. When there were more than one expert for a TTA (e.g., in the case of MD6 and TP1), a joint interview was held. Table 1 provides interviewees' demographic data.

ID	Role / Function	Gender	Years in position	Number of public transport companies	Passengers per year (in millions) [a]
MD1	Managing director	Male	5	≥ 40	≤ 400
MD2	Managing director	Male	4	≤ 10	≤ 300
MD3	Managing director	Female	6	≤ 30	≤ 200
MD4	Managing director	Female	11	≤ 20	≤ 50
MD5	Managing director	Male	6	≤ 10	≤ 50
MD6	Managing director	Male	2	≤ 30	≤ 50
TP1	Transport planning	Male	1		
MD7	(Deputy) Managing director	Male	12	≤ 10	n.a.
MD8	(Deputy) Managing director	Male	6	≤ 20	≤ 50
PM1	Project manager	Male	1		
AR1	Authorized representative	Female	6	≥ 40	≤ 300
TP2	Transport planning	Female	2		
PM2	Project manager [b]	Male	2	≤ 20	≤ 200
PM3	Project manager	Male	6	≤ 30	≥ 700
OM1	Office manager	Male	1	≤ 20	≤ 50

a) Latest available figures.

b) Excluded from further analysis. The interviewee disclosed that the TTA had recently signed a letter of intent with a D2D mobility integrator.

Table 1. Overview of interviewees and their TTAs.

A semi-structured interview guideline was developed including questions on D2D mobility integrator roles and potential intra-role conflicts. The questions encompass technical (e.g., availability of electronic tickets) as well as more business-related topics like the general willingness of the TTA to sell tickets through D2D mobility integrators. In addition, secondary data (association reports, press releases, etc.) about the interviewed entities was collected through the website and via publicly available data sources before the interviews were conducted. These secondary data was used in order to make specific inquiries and to validate the statements of the experts. This data triangulation strategy follows the recommendation of Flick (2009) and Miles et al. (2014). The interviews took place between October and November 2016, and lasted between 40 and 75 minutes. All interviews were recorded and transcribed.

For our qualitative data analysis, we used the software program NVivo 10. In the first round, we scanned and coded the data parallel to data collection. The coding categories were derived from the roles for D2D mobility integrators as described above. When gaps were discovered, the interview guideline was adjusted. During a second round of analysis, the codes from the single interviews were related to each other (Miles et al., 2014). Data collection and analysis was completed after incremental learning about the roles and intra-role conflicts was minimal, as recommended by Yin (2014).

4 Analysis Results

Following D2D mobility integrator roles, we analyzed what intra-role conflicts inhibit TTAs cooperation. In only one case, TP2, could an intra-role conflict be identified that related to the **informational role**. Overall, the interviewees confirmed that a D2D mobility integrator should inform customers about single component mobility services, the overall D2D trip, as well as suitable alternatives (MD1, MD2, MD4, MD8, PM3). Customers *"need good, clear information"* (MD3), and *"should also get information about mobility platforms [of D2D mobility integrators] which may have nothing directly to do with us"* (MD4). It was noted that advanced IT makes this information *"very comfortable and easy to image [e.g., transfers, trip duration]"* (OM1). Overall, it is important that a customer *"gets the information where s/he looks for it"* (MD2). In line with the definition of the informational role, the interviewees also stressed that they wished to receive information about customers. Examples include motion profiles (MD4), requested routings (MD4, MD6), different sales figures like proportion of public transport sales to total sales of a D2D mobility integrator (MD3), and socio-demographic data (AR1, PM1), which can be used in order to improve traffic planning and, as a result, component mobility services (MD1, MD4, MD7, PM1).

In contrast, expectations towards the **transactional role** reveal differentiated results. Although most interviewees (MD3, MD5, MD7, PM1, TP1) agree that providing one-stop purchasing would be the optimal solution for the customer, only a few (PM1, TP1) would favor D2D mobility integrators handling this task without constraints. The interviewees mentioned several reasons for their reluctance. MD5 compares the situation with that in the hotel sector, fearing dependency and financial disadvantage, stating that *"a customer does not book a hotel directly, but rather through a portal which charges the hotel. […]. [However,] formerly, the hotelier received this money. Prices cannot be easily increased due to intensified competition […, and] direct comparison"*. The same is true for public transport companies, which increasingly compete with new market entrants such as car-sharing, and ride-sharing companies. In this context, interviewees point out that the TTA has a strong competitive disadvantage because *"tariffs must be approved two weeks in advance"* (MD4) and zone tariffs are used instead of pure distance prices (MD1). Similarly, MD4 (comparable AR1) challenges the transactional role – *"I must say: Tickets will not be sold externally"* – because the interviewee struggles to answer the question *"how does the business model work? This is what I quite honestly do not understand at this point"*. More specifically, s/he is unable to understand how D2D mobility integrators *"can sell tickets at a 50% discount rate […, and simultaneously guarantee] the full price"* for the TTA. In terms of costs, interviewees didn't expect significant savings due to sales by D2D mobility integrators. MD4 (similar MD2) does *"not believe that s/he will be able to close a different distribution channel at some point because paper tickets will be around for a very long time"*. Against this background, MD5 added that at least in the case of its own mobile ticketing the sales commission is very high and *"public transport companies have lower earnings than through other distribution channels"*. MD1 describes an *"optimal ticketing solution"* of D2D mobility integrators as a be-in/be-out system where the customers *"do not have to do anything"*. *"Any devices available in the bus as well as […] on the body [e.g., smartphone] can record that you just took the bus from A to B"* (MD1). Subsequently, this data could be used to generate a monthly invoice. However, the interviewees do not expect such an advanced solution in the foreseeable future, mainly because the TTAs themselves are unable to provide the necessary technical equipment (AR1, MD8). It can be summarized that nearly all TTAs, at least in part, reject the transactional role of D2D mobility integrators.

MD1 and MD7 confirm that the guarantee of payment is an essential part of the **assurance role**. Two TTAs prefer to retain the assurance role for themselves to ensure information quality before customers make a purchase. For example, MD2 (similar to MD4) expressed the desire to ensure the information quality of its component mobility services because s/he distrusts the *"data finishing processes [of D2D mobility integrators], where customers are confronted with information […] which has been altered"* and expects *"to be held responsible"* for the misinformation. In this context, however, is worth mentioning that almost all interviewees (e.g., AR1, MD3, MD4, OM1, TP1) state that some of their public transport companies are unable to provide real-time timetable data. In addition, in cases when (expected) quality is not provided (delay, dirty seats, etc.), the TTAs (MD6, MD8, TP1) want customers to interact directly with the TTA or the public transport company and not the D2D mobility integrator. The main reason for this is that in the case of indirect distribution such as through D2D mobility integrators, if a quality complaint *"goes to court, the customer and the public transport company will be at the table"* (AR1, see also MD1, MD8, TP1). As a result, TTAs strive to retain full control about the complaint management process because they fear the negative effects of *"Chinese whispers"* (TP1).

Interviewees clearly expect a much smarter assurance role before they enter a cooperation and delegate quality management. PM1 suggested a possible future technical solution, *"whereby a smart software program could identify which public transport company is responsible based on the location of the quality failure [e.g., a delay]",* which would help solve the problem of statutory responsibility.

The fact that TTAs referring to legal complexities for their non-cooperation also show that they currently primarily adopt an inside-out rather than an outside-in perspective. Wording like *"if there is a delay at* *the destination train station the only thing one can do is say: Okay, this is in the field of responsibility of the feeder bus company and if it offers no compensation […], so the customer simply had bad luck"* (MD2) illustrates that the interviewees are narrowly focused on the design of their own component mobility services. This inside-out thinking, however, is an all but obsolete relict from the period before alternative mobility offerings (car-sharing, etc.) gained prominence when TTAs enjoyed local monopolies. Today, customers expect a more integrated D2D mobility including a continuous compensation system.

The **logistical role** is characterized by an intra-role conflict resulting from the inability of many, but particularly small and medium TTAs (e.g., MD4, MD6, OM1) to deliver electronic and/or mobile credentials such as tickets and reservations. As a result, D2D mobility integrators are unable to conduct a simple integration of IT. The reasons for the non-implementation of advanced IT are primary economic and organizational in nature. According to MD6, investments are not profitable because *"[ticket] sales costs are often identical to the amount of sales, and that cannot be the case"*. Similarly, MD4 emphasized that a mobile solution *"is a permanent cost factor"* without *"additional revenue"*. In addition, TTAs struggle to deliver mobile credentials – *"just short of implementation, but it failed again, sadly"* (AR1) – because the current tariff system is very complex and existing *"IT is not capable of supporting"* (AR1) implementation (also mentioned by OM1). The interviews did not provide any further indications of intra-role conflicts at the logistical role, probably mainly because additional documents and their verification (driver's license, etc.) are not needed to ride public transport.

Lastly, an important intra-role conflict arose in the analysis of the **customization role**. Although the context-aware and dynamic integration of component mobility services is regarded as a key characteristic of smart D2D mobility integrators, nearly all of the interviewees strongly emphasized their desire to take on this role themselves: *"I say as a TTA we are the intermediary that offers customers alternative mobility"* (MD4). Apparently, TTAs have invested significant resources into solutions to provide D2D mobility themselves. However, to date, the majority of projects are still in an early stage and focus only on local D2D trips (MD3, MD5, MD7, MD8, PM1). By contrast, the interviewees (e.g., MD2, MD5, MD7) assume that a Germany-wide offer would only attract *"a handful of customers"* (MD2). These statements show that there is apparently a large information asymmetry between some of the TTAs and D2D mobility integrators concerning the mobility market and its future development. As a result of the differing expectations of TTAs, a cooperation does not appear to be mandatory for economic reasons (branding, sales, etc.). But not all interviewees shared this pessimistic view or considered D2D mobility integrators as competitors to their own local D2D mobility solutions. As PM3 (see also e.g., MD1, MD3) stated *"we need to strengthen our own platform, but we must also be present on other platforms [such as these from D2D mobility integrators]"*.

In summary, as depicted in Figure 2, a high number of intra-role conflicts inhibit the cooperation of TTAs with D2D mobility integrators. Quotations by each interviewee served as basis for our categorization (clear, partial, and no conflict). A clear conflict is characterized by a complete rejection of a role, whereas in the case of a partial conflict there are arguments for and against acceptance of a role.

Figure 2. Intra-role conflicts inhibiting cooperation.

The clearest and, thus, presumably the most persistent conflicts related to the logistical and the customization role. Especially the strong preference on the part of TTAs to take the customization role themselves makes it difficult to expect that D2D mobility integrators will realize large-scale cooperation quickly. This expectation is strengthened by the frequent rejection of the logistical role because TTAs are at least currently unable to provide the IT necessary for integration. Conversely, few intra-role conflicts stem from TTAs' expectation that D2D mobility integrators should offer smarter D2D mobility.

5 Implications

Our results have several implications for research and practice. First, this paper contributes to the stream of smart integrator research, which is in the fledging stage and where the need for research is great (Alt et al., 2016; Beverungen et al., 2016; Willing et al., 2017b). Initially, we illustrated the evolution of intermediaries. In this context, we argued that due to technical progress (access to data, sensors, etc.) service integrators will become 'smarter' in future. Based on existing literature (e.g., Gretzel et al., 2015; Rocznik et al., 2017), we defined intermediaries that offer individual, context-aware and dynamic service packages as '*smart integrators'*.

Second, we show that the role framework provided by Barnes and Hinton (2007) can be adapted to analyze the roles of D2D mobility integrators, which are a subgroup of smart integrators. All interviewees underscored the significance of these roles and the associated tasks when thinking about the position of D2D mobility integrators in the mobility market.

Third, we applied role conflict theory (e.g., Koch and Schultze, 2011; Merton, 1957) to examine the relationship between intra-role conflicts and the inability of D2D mobility integrators to offer D2D mobility comprehensively. Our results illustrate that intra-role conflicts negatively influence the willingness of TTAs to cooperate and hence the business model of D2D mobility integrators. Thus, the approach used may help to understand the "underlying mechanisms and phenomena of business model success and failure" as demanded by Veit et al. (2014, p. 50). More specifically, our results provide evidence of the frequent rejection of an intermediary position of D2D mobility integrators by TTAs. This is in line with the previous literature concerning e-intermediaries (e.g., Tay and Chelliah, 2011). On the other hand, the results indicate that TTAs only partially expect D2D mobility integrators to offer smarter D2D mobility. One reason for this is that they themselves are often unable to provide the required component mobility services (with real-time timetable data, etc.) due to insufficient IT capability. Nevertheless, the interviewees expect that the application of advanced IT can be used to remove some barriers to cooperation.

Apart from this, there are numerous more practical implications. Our results suggest that German D2D mobility integrators are likely to remain stuck in business models that rely primarily on taking the informational role if they wish to gain the cooperation of TTAs. This could be seen as a result of the lack of advanced IT capabilities. TTAs are often not able to recognize and reap the potential benefits provided when D2D mobility integrators act as smart integrators. For example, their revenues could increase through dynamic pricing (Kannan and Kopalle, 2001), or business area optimization (Willing et al., 2017a). Against this background, especially policy makers (e.g., cities, districts, federal states), as frequent shareholders of TTAs, should question their financing behavior. This also applies to TTAs' attempts to defend their 'local empires' by offering own D2D mobility. A fragmented landscape of local projects is unable to provide D2D mobility which is a real alternative to private car use. Given the fact that the mobility sector is one of the primary sources of greenhouse gases (Watson et al., 2011), a corresponding rethinking could be a crucial factor in slowing or stopping global warming.

Conversely, D2D mobility integrators should prove how business models can be developed based on the informational role, such as by including information about additional services (dining, entertainment, etc.) or by monetizing location-based advertising. In addition, they should try to provide consistently high-quality information. Given the inability of many TTAs to provide real-time timetable information for all of their public transport companies, D2D mobility integrators should examine alternative data sources. One approach could be to integrate dynamic data available through passengers' smartphones, following the lead of Google Maps™.

6 Limitations and Future Research

Our study has some limitations which should be addressed in future research. First of all, it is limited to the mobility sector. Although this sector is considered an important area for smart integrators (Alt et al., 2016; Beverungen et al., 2016), further research should expand the focus. Interesting examples may be found in the medical tourism sector where (smart) integrators package component services such as accommodation, surgery, and transfer (Connell, 2006). Second, our study was limited to German TTAs. Even though public transport companies are very important in providing valuable D2D mobility, alternative mobility providers (e.g., car-sharing, and taxi companies) as well as additional countries should also be analyzed. While the results are expected to be at least transferable to European countries with a similar organisational structure (Austria, Switzerland, etc.) they cannot easily be transferred, for example, to developing countries (Marx et al., 2015). In addition, customer expectations on D2D mobility integrator roles should be examined to identify and solve possible intra-role conflicts. Third, the roles of D2D mobility integrators were only indirectly derived from existing literature (Albrecht and Ehmke, 2016; Barnes and Hinton, 2007; Willing et al., 2017a; 2017b, etc.). Future research should be conducted with D2D mobility integrators to confirm the adapted role framework, as well as to identify possible inter-role conflicts (i.e., the conflicts between different roles of a D2D mobility integrator) inhibiting the business model. Moreover, an overarching role framework for smart integrators which recognizes the technical progress of IT should be drawn up. Lastly, interviewing experts is a good starting point for understudied research topics like smart integrators, in general, and D2D mobility integrators, in particular. However, further quantitative analyses are needed to ensure validity of the results.

7 Conclusion

We examined how intra-role conflicts impede the ability of D2D mobility integrators to offer smart D2D mobility. Our approach is novel in its adaptation of an existing role framework for e-intermediaries to account for D2D mobility integrators and the analysis of intra-role conflicts.

We conducted qualitative interviews with experts from twelve German TTAs to evaluate their views concerning the roles of D2D mobility integrators and to reveal intra-role conflicts, identifying the most important ones with regard to the logistical and the customization role. We found that most TTAs are unable to support the delivery of electronic/mobile credentials (i.e., tickets and reservations) as they lack sophisticated IT solutions. We also found that TTAs often prefer to take an exclusive customization role when they initiate their own D2D mobility projects. Due to changes in customer demand as well as rising political pressure, such a non-cooperation behavior is not expected to be sustainable.

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References

Aditjandra, P. T., J. D. Nelson, and S. D. Wright (2009). “A Multi-Modal International Journey Planning System: A Case Study of WISETRIP.” In: *Proceedings of the World Congress and Exhibition on Intelligent Transport Systems*. Stockholm.

Albrecht, L. and J. F. Ehmke (2016). “Innovative Services in der Mobilitätsbranche: Eine Marktanalyse Multimodaler Mobilitätsmanager.” In: *Proceedings of the Multikonferenz Wirtschaftsinformatik*. Ilmenau.

Allen, G. and J. Wu (2010). “How Well Do Shopbots Represent Online Markets? A Study of Shopbots’ Vendor Coverage Strategy.” *European Journal of Information Systems* 19 (3), pp. 257-272.

Allen, T. D., D. E. L. Herst, C. S. Bruck, and M. Sutton (2000). "Consequences Associated with Work-to-Family Conflict: A Review and Agenda for Future Research." *Journal of Occupational Health Psychology* 5 (2), pp. 278-308.

Allison, M. T. (1991). "Role Conflict and the Female Athlete: Preoccupations with Little Grounding." *Journal of Applied Sport Psychology* 3 (1), pp. 49-60.

Alt, R. (2016). "Electronic Markets on Customer-Orientation." *Electronic Markets* 26 (3), pp. 195-198.

Alt, R., H. Demirkan, J. F. Ehmke, A. Moen, and A. Winter (2016). "Call for Papers. Smart Services: The Move to Customer-Orientation." *Electronic Markets*.

Anderson, P. and E. Anderson (2002). "The New E-Commerce Intermediaries." *MIT Sloan Management Review* 43 (4), pp. 53-62.

Arumugam, S. (2013). "Perceptions & Expectations of the Roles & Functions of the IT Project Management Office." In: *Proceedings of the Pacific Asia Conference on Information Systems*. Jeju Island.

Bakos, Y. (1998). "The Emerging Role of Electronic Marketplaces on the Internet." *Communications of the ACM* 41 (8), pp. 35-42.

Barnes, D. and M. Hinton (2007). "Developing a Framework to Analyse the Roles and Relationships of Online Intermediaries." *International Journal of Information Management* 27 (2), pp. 63-74.

Barth, M. and K. Boriboonsomsin (2008). "Real-World Carbon Dioxide Impacts of Traffic Congestion." *Transportation Research Record: Journal of the Transportation Research Board* 2058, pp. 163-171.

Baumöl, U. and R. Winter (2001). "Intentions Value Network: A Business Model of the Information Age." In: *Proceedings of the International Conference on Enterprise Information Systems*. Setubal.

Bengtsson, M. and S. Kock (2015). "Tension in Co-Opetition." In: *Creating and Delivering Value in Marketing.* Ed. by H. E. Spotts. Springer. Cham. pp. 38-42.

Berger, S. C. and F. Gleisner (2009). "Emergence of Financial Intermediaries in Electronic Markets: The Case of Online P2P Lending." *BuR - Business Research* 2 (1), pp. 39-65.

Beutel, M. C., S. Gökay, W. Kluth, K.-H. Krempels, C. Samsel, and C. Terwelp (2014a). "Product Oriented Integration of Heterogeneous Mobility Services." In: *Proceedings of the International Conference on Intelligent Transportation Systems*. Qingdao.

Beutel, M. C., C. Samsel, M. Mensing, and K.-H. Krempels (2014b). "Business Model Framework to Provide Heterogeneous Mobility Services on Virtual Markets." In: *Proceedings of the International Conference on e-Business*. Vienna.

Beverungen, D., C. F. Breidbach, J. Poeppelbuss, and V. K. Tuunainen (2016). "Call for Papers. Smart Service Systems: An Interdisciplinary Perspective." *Information Systems Journal*.

Biddle, B. J. (1979). *Role Theory: Expectations, Identities, and Behaviors*. New York: Academic Press.

Boero, M., M. Garré, J. Fernandez, S. Persi, D. Quesada, and M. Jakob (2016). "MyWay Personal Mobility: From Journey Planners to Mobility Resource Management." *Transportation Research Procedia* 14, pp. 1154-1163.

Brousseau, E. (2002). "The Governance of Transactions by Commercial Intermediaries: An Analysis of the Re-Engineering of Intermediation by Electronic Commerce." *International Journal of the Economics of Business* 9 (3), pp. 353-374.

Chen, L., A. Mislove, and C. Wilson (2015). "Peeking Beneath the Hood of Uber." In: *Proceedings of the ACM Internet Measurement Conference*. Tokyo.

Chowdhury, I. N., T. Gruber, and J. Zolkiewski (2016). "Every Cloud Has a Silver Lining - Exploring the Dark Side of Value Co-Creation in B2B Service Networks." *Industrial Marketing Management* 55, pp. 97-109.

Connell, J. (2006). "Medical Tourism: Sea, Sun, Sand and … Surgery." *Tourism Management* 27 (6), pp. 1093-1100.

Consulting4Drive and BSL Transportation Consultants (2015). "Intermodale Verkehrskonzepte in Deutschland".

de Reuver, M., H. Bouwman, and T. Haaker (2009). "Mobile Business Models: Organizational and Financial Design Issues That Matter." *Electronic Markets* 19 (1), pp. 3-13.

Dowling, M. J., W. D. Roering, B. A. Carlin, and J. Wisnieski (1996). "Multifaceted Relationships under Coopetition: Description and Theory." *Journal of Management Inquiry* 5 (2), pp. 155-167.

Ehmke, J. F., D. C. Mattfeld, and L. Albrecht (2016). "Position Paper: Combining Mobility Services by Customer-Induced Orchestration", in: *Workshop on Recommenders in Tourism*, Boston.

Flick, U. (2009). *An Introduction to Qualitative Research*. London: SAGE Publications.

Giaglis, G. M., S. Klein, and R. M. O'Keefe (2002). "The Role of Intermediaries in Electronic Marketplaces: Developing a Contingency Model." *Information Systems Journal* 12 (3), pp. 231-246.

Glaser, B. G. and A. L. Strauss (1967). *The Discovery of Grounded Theory: Strategies for Qualitative Research*. New York: Aldine de Gruyter.

Gogos, S. and X. Letellier (2016). "IT2Rail: Information Technologies for Shift to Rail." *Transportation Research Procedia* 14, pp. 3218-3227.

Gretzel, U., M. Sigala, Z. Xiang, and C. Koo (2015). "Smart Tourism: Foundations and Developments." *Electronic Markets* 25 (3), pp. 179-188.

Havila, V. (1992). "Intermediary and Role Expectations in International Business Relationships." In: *Proceedings of the International Markets and Processes*. Lyon.

Heinonen, K. and T. Strandvik (2015). "Customer-Dominant Logic: Foundations and Implications." *Journal of Services Marketing* 29 (6/7), pp. 472-484.

Heinrich, B. and R. Winter (2004). "A Strategy Modelling Technique for Financial Services." In: *Proceedings of the European Conference on Information Systems*. Turku.

Heinrich, B., G. Zellner, and S. Leist (2011). "Service Integrators in Business Networks—the Importance of Relationship Values." *Electronic Markets* 21 (4), pp. 215-235.

Kannan, P. K. and P. K. Kopalle (2001). "Dynamic Pricing on the Internet: Importance and Implications for Consumer Behavior " *International Journal of Electronic Commerce* 5 (3), pp. 63-83.

Koch, H. and U. Schultze (2011). "Stuck in the Conflicted Middle. A Role-Theoretic Perspective on B2B E-Marketplaces." *MIS Quarterly* 35 (1), pp. 123-146.

Koch, H., S. Zhang, L. Giddens, N. Milic, K. Yan, and P. Curry (2014). "Consumerization and IT Department Conflict." In: *Proceedings of the International Conference on Information Systems*. Auckland.

Leifer, R. and A. Delbecq (1978). "Organizational/Environmental Interchange: A Model of Boundary Spanning Activity." *Academy of Management Review* 3 (1), pp. 40-50.

Lu, X., S. Gao, and E. Ben-Elia (2011). "Information Impacts on Route Choice and Learning Behavior in a Congested Network: Experimental Approach." *Transportation Research Record* 2243, pp. 89-98.

Lusch, R. F. and S. Nambisan (2015). "Service Innovation: A Service-Dominant Logic Perspective." *MIS Quarterly* 39 (1), pp. 155-175.

Marx, R., A. M. de Mello, M. Zilbovicius, and F. F. de Lara (2015). "Spatial Contexts and Firm Strategies: Applying the Multilevel Perspective to Sustainable Urban Mobility Transitions in Brazil." *Journal of Cleaner Production* 108, pp. 1092-1104.

Masuch, N., M. Lützenberger, and J. Keiser (2013). "An Open Extensible Platform for Intermodal Mobility Assistance." *Procedia Computer Science* 19, pp. 396-403.

Merton, R. K. (1957). "The Role-Set: Problems in Sociological Theory." *The British Journal of Sociology* 8 (2), pp. 106-120.

Miles, M. B., A. M. Huberman, and J. Saldaña (2014). *Qualitative Data Analysis: A Methods Sourcebook*. Los Angeles: SAGE Publications.

Monheim, H. and K. G. Schroll (2005). "Von der Defensive zur Offensive - Mehr Akzeptanz für Innovative Konzepte im Öffentlichen Verkehr bei professionellen Akteuren." *Verkehrszeichen* 21 (2), pp. 4-8.

Motta, G., D. Sacco, A. Belloni, and L. You (2013). "A System for Green Personal Integrated Mobility: A Research in Progress." In: *Proceedings of the International Conference on Service Operations and Logistics, and Informatics*. Dongguan.

Münchner Kreis e.V. (2017). "Mobility. Fulfilment. System: On the Future of Mobility 2025+."

Noble, G. and R. Jones (2006). "The Role of Boundary-Spanning Managers in the Establishment of Public-Private Partnerships." *Public Administration* 84 (4), pp. 891-917.

Perrone, V., A. Zaheer, and B. McEvily (2003). "Free to Be Trusted? Organizational Constraints on Trust in Boundary Spanners." *Organization Science* 14 (4), pp. 422-439.

Reinhardt, W. (2012). *Öffentlicher Personennahverkehr: Technik - Rechtliche und Betriebswirtschaftliche Grundlagen*. Wiesbaden: Vieweg+Teubner Verlag.

Rocznik, D., K. Goffart, M. Wiesche, and H. Krcmar (2017). "Towards Identifying User-Centered Requirements for Smart In-House Mobility Services." *KI-Künstliche Intelligenz* 31 (3), pp. 249-256.

Sage, G. H. and S. Loudermilk (1979). "The Female Athlete and Role Conflict." *Research Quarterly* 50 (1), pp. 88-96.

Sarkar, M. B., B. Butler, and C. Steinfield (1995). "Intermediaries and Cybermediaries: A Continuing Role for Mediating Players in the Electronic Marketplace." *Journal of Computer-Mediated Communication* 1 (3).

Schulz, T., R. Rockmann, and A. Weeger (2016). "Service Composition in Networks – Towards a Typology of Intermediaries", in: *Americas Conference on Information Systems*, San Diego.

Schulz, T. and M. Überle (2018). "How Institutional Arrangements Impede Realization of Smart Ecosystems: The Case of Door-to-Door Mobility Integrators." In: *Proceedings of the European Conference on Information Systems*. Portsmouth.

Sen, R. and R. C. King (2003). "Revisit the Debate on Intermediation, Disintermediation and Reintermediation Due to E-Commerce." *Electronic Markets* 13 (2), pp. 153-162.

Shalaik, B. and A. Winstanley (2011). "Delivering Real-Time Bus Tracking Information on Mobile Devices." In: *Proceedings of the FutureTech*. Loutraki.

Standing, C., J.-P. Tang-Taye, and M. Boyer (2014). "The Impact of the Internet in Travel and Tourism: A Research Review 2001–2010." *Journal of Travel & Tourism Marketing* 31 (1), pp. 82-113.

Su, N. (2013). "Internationalization Strategies of Chinese IT Service Suppliers." *MIS Quarterly* 37 (1), pp. 175-200.

Subberwal, R. (2009). *Dictionary of Sociology*. New Delhi: Tata McGraw-Hill Publishing.

Tay, K. B. and J. Chelliah (2011). "Disintermediation of Traditional Chemical Intermediary Roles in the Electronic Business-to-Business (E-B2B) Exchange World." *Journal of Strategic Information Systems* 20 (3), pp. 217-231.

van Liere, D., P. Vervest, B. Konsynski, and C. Holland (2010). "IS in Interorganizational Networks." *European Journal of Information Systems* 19 (4), pp. 432-435.

Veit, D., E. Clemons, A. Benlian, P. Buxmann, T. Hess, M. Spann, D. Kundisch, J. M. Leimeister, and P. Loos (2014). "Business Models. An Information Systems Research Agenda." *Business & Information Systems Engineering* 6 (1), pp. 45-53.

Verband Deutscher Verkehrsunternehmen (2016). "2015 Statistik."

Walley, K. (2007). "Coopetition: An Introduction to the Subject and an Agenda for Research." *International Studies of Management & Organization* 37 (2), pp. 11-31.

Watson, R. T., M.-C. Boudreau, A. J. Chen, and H. H. Sepúlveda (2011). "Green Projects: An Information Drives Analysis of Four Cases." *Journal of Strategic Information Systems* 20 (1), pp. 55-62.

Wikipedia (2016). *Liste Deutscher Tarif- und Verkehrsverbünde*. URL: https://de.wikipedia.org/wiki/Liste_deutscher_Tarif-_und_Verkehrsverb%C3%BCnde (visited on 23-09-2016).

Willing, C., T. Brandt, and D. Neumann (2017a). "Electronic Mobility Market Platforms – a Review of the Current State and Applications of Business Analytics." *Electronic Markets* 27 (3), pp. 267-282.

Willing, C., T. Brandt, and D. Neumann (2017b). "Intermodal Mobility." *Business & Information Systems Engineering* 59 (3), pp. 173-179.

Winter, A., R. Alt, J. Ehmke, R. Haux, W. Ludwig, D. Mattfeld, A. Oberweis, and B. Paech (2012). "Manifest–Kundeninduzierte Orchestrierung Komplexer Dienstleistungen." *Informatik-Spektrum* 35 (6), pp. 399-408.

Xiang, Z., V. P. Magnini, and D. R. Fesenmaier (2015). "Information Technology and Consumer Behavior in Travel and Tourism: Insights from Travel Planning Using the Internet." *Journal of Retailing and Consumer Services* 22, pp. 244-249.

Yin, R. K. (2014). *Case Study Research: Design and Methods*. 5th Edition. Thousand Oaks: SAGE Publications.

Appendix E. How Institutional Arrangements Impede Realization of Smart Ecosystems: The Case of Door-To-Door Mobility Integrators (P4)

HOW INSTITUTIONAL ARRANGEMENTS IMPEDE REALIZATION OF SMART ECOSYSTEMS: THE CASE OF DOOR-TO-DOOR MOBILITY INTEGRATORS

Research paper

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Abstract

Technical progress has enabled companies to offer smart services. In the mobility sector, emerging door-to-door (D2D) mobility integrators promise to provide highly individualized, dynamic, and context-aware mobility service by bundling different mobility services, such as car-sharing and public transport. These D2D mobility integrators are well-positioned to facilitate access and use of non-private car-based mobility and thus to contribute to solutions to major challenges facing cities around the world, such as traffic congestion and air pollution. However, D2D mobility integrators struggle to attract mobility providers to their service ecosystem.

This research applies the concept of legitimacy, which originates from institutional theory, and service-dominant (S-D) logic to analyse the current embeddedness of mobility providers in service ecosystems and the underlying institutional arrangements as a possible barrier to entering into a D2D mobility integrator service ecosystem.

An exploratory study with German mobility providers was conducted. Our empirical results show that embeddedness in already existing service ecosystems, in particular, reduces their need to gain market legitimacy and for the legitimacy of the new type of smart cooperation. These lead to a lack of cooperation with D2D mobility integrators.

Keywords: Institutional Theory, Legitimacy, Service-dominant Logic, Smart Mobility.

1 Introduction

Cities around the world are confronted with the challenge of creating new mobility paradigms in order to improve the living conditions of their citizens and to preserve the environment for future generations. Currently, private car use constitutes a large share of total mobility (TCI Röhling Transport Consulting International, 2016), causing problems like traffic congestion, parking problems (Arnott and Inci, 2006; Giuffrè et al., 2012), as well as air and noise pollution (Barth and Boriboonsomsin, 2008; Murphy and Delucchi, 1998; Willing et al., 2017a; 2017b). Given the estimation that the percentage of the worldwide population living in cities will rise up from 50% in 2015 to 66% by 2050 (United Nations Department of Economic and Social Affairs, 2015), solutions are needed now more than ever.

New possibilities are provided by the proliferation of information technology (IT) like smartphones, and ongoing technical progress (sensors, etc.). Several mobility services such as car-sharing (Firnkorn and Müller, 2011; Hildebrandt et al., 2015), bike-sharing (Shaheen et al., 2010), or ride-sharing (Teubner and Flath, 2015) have become much simpler and more convenient to use, contributing to their increased popularity and thus to less dependency on private car use. More recently, in a manifestation of Arthur (2009, p. 194) observation that "technology creates the structure of the economy", an entirely new market actor has emerged. So-called door-to-door (D2D) mobility integrators aimed to offer smart D2D mobility, which is characterized by individual, context-aware, and dynamic packaging of mobility services provided by different mobility providers like bus, car-sharing, or train companies (Schulz et al., 2018). D2D mobility services save customers time and energy by eliminating the need to search through myriad mobility service offerings as well as challenging on-trip adaptations, for example, due to short-term cancellations or delays. For these reasons, D2D mobility integrators are well-positioned to better fulfil city dwellers' mobility needs (Alt, 2016; Winter et al., 2012) and to provide a viable alternative to private car use. As a result, it is expected that D2D mobility services will command the largest share of the mobility market (Consulting4Drive and BSL Transportation Consultants, 2015).

However, whereas there is little doubt about the value of the services D2D mobility integrators can offer, technical implementation of these D2D mobility services is still its infancy. A recent study by Willing et al. (2017b) finds that all government-backed projects have either been abandoned or are not yet in full operation. A handful of private-sector solutions (e.g., Moovel, Qixxit) are on the market, but the D2D mobility services provided lack important features of smart mobility, such as a booking/payment functionality and access to a larger number of mobility providers and their services to offer alternative D2D trips (Willing et al., 2017a; 2017b). Albrecht and Ehmke (2016), for instance, find that D2D mobility integrators are often unable to integrate the mobility services of public transport (56%), or station-based car-sharing companies (78%) into their technical solutions.

To date, D2D mobility integrators and their difficulties have been largely ignored by research (Willing et al., 2017b). In this exploratory paper, we partly fill this gap by exploring how mobility providers like bus, car-sharing, or train companies can be convinced to cooperate with D2D mobility integrators. Some studies (e.g., Beirão et al., 2017; Frow et al., 2016; Vargo and Lusch, 2017; Vargo et al., 2008) have examined service provision by multiple actors using service-dominant (S-D) logic and its underlying concepts of service ecosystem and value co-creation as an investigatory lens. However, these studies are often on a meta-theoretical level (Vargo and Lusch, 2017), are without empirical evidence (see Giesbrecht et al., 2017), and seldom incorporate IT as an enabler (Breidbach and Maglio, 2016). To further develop S-D logic towards a midrange theory, framework, and model, Vargo and Lusch (2017) proposed using non-marketing theories.

In management literature, different theories like transaction cost theory (Barney and Hesterly, 2006; Ireland et al., 2002), the resource-based view (Eisenhardt and Schoonhoven, 1996), social network theory (Ahuja, 2000; Kenis and Knoke, 2002), organizational learning theory (Kale et al., 2000), and institutional theory (Dacin et al., 2007; Oliver, 1990) have been used to examine rationales for dyadic strategic alliance formation. Given the expected high importance of institutions, which are "humanly devised rules, norms, and beliefs that enable and constrain action" (Scott, 2008; Vargo and Lusch, 2017, p. 49), and their higher-level institutional arrangements in establishing a service ecosystem (Koskela-Huotari et al., 2016a; Vargo and Lusch, 2016; 2017; Vargo et al., 2015), we draw on institutional theory and its concept of legitimacy. We argue that a mobility provider and its activities must conform to institutional arrangements, and, if the resulting pressure is strong enough, enter into a service ecosystem of a D2D mobility integrator for legitimacy purposes (Dacin et al., 2007). Taking into account the low cooperation rate of mobility providers, our research questions is: *How do existing institutional arrangements impede the need of mobility providers to gain legitimacy and thus act as barriers to their cooperation with D2D mobility integrators?*

To approach this research question, we conducted explorative interviews with experts from thirteen German mobility providers. Analysing mobility providers as a potential part of the IT-enabled service ecosystem of D2D mobility integrators, we present their lack of legitimacy needs as a result of existing institutional arrangements. After introducing the theoretical background, we explain our methodology, and present and discuss our results.

2 Theoretical Background

2.1 Service Ecosystem of D2D Mobility Integrators: A Service-Dominant Logic Perspective

Traditional scientific literature is grounded on a goods-dominant (G-D) logic, which is characterized by a company and output-centric perspective. Their central characteristics are the assumption that customers exchange for goods, i.e., primarily manufactured things such as cars, and that their value is determined by the producers (value-in-exchange). Hence, customers are solely passive recipients of goods, which they receive on the market (Vargo and Lusch, 2004).

In 2004, Vargo and Lusch (2004; 2016; 2017) introduced a new service-dominant (S-D) logic into marketing. More recently, a high number of authors from different research fields (e.g., Hearn et al., 2007; Jarvis et al., 2014; Storbacka et al., 2016), including service science (Maglio et al., 2009; Spohrer and Maglio, 2010, etc.), and information systems (IS) (e.g., Giesbrecht et al., 2017; Lusch and Nambisan, 2015; Schmidt-Rauch and Schwabe, 2014), also adopted this perspective. According to S-D logic, service, which is defined as "the application of resources for the benefit of others" (Vargo and Lusch, 2017, p. 48), is the basis of exchange (Vargo et al., 2008). Thereby, the former differentiation between customers and producers is becoming obsolete, assuming that all actors engage in service-for-service exchange, i.e., resource integration activities (Vargo and Lusch, 2016; 2017). For instance, customers have to provide their GPS data to D2D mobility integrators in order to get context-aware, dynamic packaging of mobility services. It also becomes clear that the particular context of an actor (e.g., the current trip home) plays an important role for its resource integration (Chandler and Vargo, 2011). Hence, the previous principle of value-in-exchange (G-D logic) is replaced by the principle of value-in-use (Vargo and Lusch, 2004), or, more precisely, by value-in-context (Chandler and Vargo, 2011; Vargo and Lusch, 2017; Vargo et al., 2008).

The service-for-service exchange connects actors in a service ecosystem, which represents "a relatively self-contained, self-adjusting system of mostly loosely coupled social and economic (resource-integrating) actors connected by shared institutional logics and mutual value creation [i.e., value co-creation] through service exchange" (Lusch and Nambisan, 2015, p. 161. For varying definitions, see Nischak et al. (2017). See Spohrer et al. (2008) for a related definition of a service system). Given this definition, the size of service ecosystems varies from small (individual households, companies, etc.) to large, such as nations and global markets (Koskela-Huotari et al., 2016a). A specific service ecosystem is thus not autonomous because its actors are embedded in multiple service ecosystems simultaneously (Akaka et al., 2013). The analysis of a service ecosystem like those of a D2D mobility integrator (see Figure 1) therefore requires zooming in and out, which Chandler and Vargo (2011) describe as oscillating foci. For example, taking a narrow focus, the D2D mobility integrator service ecosystem consists at least of customers and different mobility providers like car-sharing, bus or train companies (1a-d). Expanding the focus makes additional actors visible, such as a national government (1a) legislating for the promotion of car-sharing parking lots in public spaces to enhance physical connection with bus and train stations (Bundesministerium für Verkehr und digitale Infrastruktur, 2017), local transport and tariff associations (1c) harmonizing tariffs between different public transport companies (Reinhardt, 2012), or industry associations (1d). These possible additional actors are indicated with black dots. The different sizes of the dots illustrate the varying number of actors' service-for-service exchange relations.

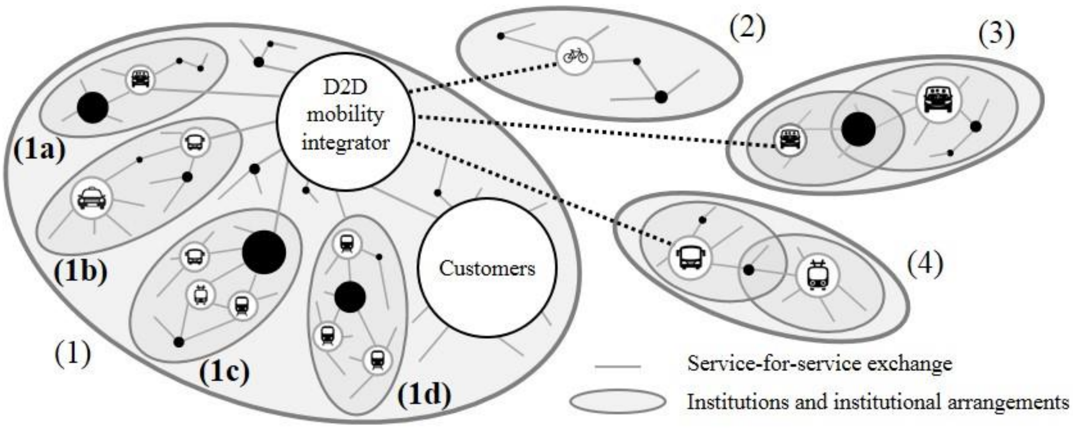

Figure 1. Exemplary service ecosystem of a D2D mobility integrator.

According to Vargo and Lusch (2017), the coordination mechanism for the actors involved in a service ecosystem and their service-for-service exchange activities are institutions and institutional arrangements (a synonym for "shared institutional logics" (e.g., Lusch and Nambisan, 2015, p. 163)). Institutions are "humanly devised rules, norms, and beliefs that enable and constrain action" (Scott, 2008; Vargo and Lusch, 2017, p. 49), what North (1990, p. 3) also calls "the rules of the game". Institutional arrangements are the higher-order collection of these interrelated institutions (Vargo and Lusch, 2017). Due to the embeddedness of actors in multiple service ecosystems, institutions and institutional arrangements also exist between service ecosystems (Akaka et al., 2013; Koskela-Huotari et al., 2016a; Lawrence and Suddaby, 2006). For instance, a car-sharing company (1a) faces institutions on a company level (corporate culture, etc.), mobility-sector level (e.g., cooperation with a D2D mobility integrator), as well as on a nation level, such as the law for the promotion of car-sharing parking lots.

However, institutions and institutional arrangements not only enable service-for-service exchange. If they are incompatible, they cause conflicts, which constrain service-for-service exchange (Akaka et al., 2013; Koskela-Huotari et al., 2016a; Vargo et al., 2015). In an extreme case, this could lead to a situation in which mobility providers being completely incapable to conduct service-for-service exchange with D2D mobility integrators. This means that the service ecosystems concerned are not nested. As depicted in Figure 1, mobility providers like car-sharing companies (3) already often cooperate through digital platforms (Remane et al., 2016). It is therefore conceivable that decision-makers do not see the necessity for cooperating with emerging D2D mobility integrators. In addition, at least in larger cities, mobility services like bus, subway, and tram transport (4) are frequently provided by subsidiaries of the same company. As a result, IT solutions are often already available which allow these mobility services to be combined (Masuch et al., 2013; Willing et al., 2017b).

By focusing on a clearly defined service ecosystem, like that of a D2D mobility integrator (1), scientific literature (Koskela-Huotari et al., 2016a, p. 2964; Lawrence and Suddaby, 2006) have recommended "breaking, making, and maintaining [of its] institutionalized rules", in order to solve its inherent conflicting institutions and institutional arrangements and thus to increase service-for-service exchange. Necessary adjustments can be initiated by the inclusion of one or more new actors (Koskela-Huotari et al., 2016a). However, S-D logic research has not yet examined how institutions and institutional arrangements that an external actor in its current service ecosystem face, such as in the case of the mobility providers (2) to (4), can prevent such a step. In order to shed more light on this issue, we expand S-D logic by introducing the concept of legitimacy (Dacin et al., 2007).

2.2 Adding the Concept of Legitimacy to Service-Dominant Logic

Whereas S-D logic-informed research – whether in an IS (e.g., Koskela-Huotari et al., 2016b; Lusch and Nambisan, 2015) or other context (Akaka et al., 2013; Vargo and Lusch, 2017, etc.) – has only more recently begun taking an institutional perspective, related institutional theory is well established in a number of scientific areas like sociology (e.g., DiMaggio and Powell, 1983; Meyer and Rowan, 1977), management (e.g., Baum and Oliver, 1991; Dacin et al., 2007; Oliver, 1990; Provan et al., 2015) and IS. Focusing on the application of institutional theory in IS research specifically, based on the literature review of Mignerat and Rivard (2009), three broad research streams can be identified.

A first stream examines the influence of institutional pressure exerted by different actors (government, suppliers, competitors, etc.) on the diffusion of IT innovations, such as electronic-trading systems (Khalifa and Davison, 2006), physician order entry systems (Kaganer et al., 2010), or electronic data interchanges (Teo et al., 2003). A second stream focuses on how actors respond to such pressure and shape institutional arrangements. Exemplary studies focus on institutionalization processes with regard to sharing platforms (Schultze and Bhappu, 2017), security standards (Backhouse et al., 2006), enterprise resource planning (ERP) systems (Lyytinen et al., 2009), and healthcare systems (Miscione, 2007; Nielsen et al., 2014). Institutional theory has also been applied with regard to the institutionalization of nascent markets like cloud computing (Lai et al., 2014; Su, 2011), couchsurfing (Marton et al., 2017) and electronic exchanges (Cousins and Robey, 2005), a category which includes the D2D mobility market. Finally, a third stream analyses the interaction between IT and existing institutions (Avgerou, 2000; Mangan and Kelly, 2009; Sia and Soh, 2007). For instance, Cho and Mathiassen (2007) find misalignment between telehealth innovation and healthcare industry infrastructure leads to a barrier for adoption.

We base our introduction of the concept of legitimacy into S-D logic to better explain how existing institutions and institutional arrangements can be barriers to mobility providers conducting service-for-service exchange with D2D mobility integrators mainly on conclusions reached in the first research stream. According to Suchman (1995, p. 574) "*legitimacy* is a *generalized perception* or *assumption* that the actions of an entity [a mobility provider] are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions [i.e., institutional arrangements of its established service ecosystem (Vargo and Lusch, 2017)]". As the analogies to the present research in brackets indicate, this definition supplements the widely accepted definition of a service ecosystem: "a relatively self-contained, self-adjusting system of mostly loosely coupled social and economic (resource-integrating) actors connected by shared institutional logics [i.e, institutions and institutional arrangements] and mutual value creation through service exchange" (Lusch and Nambisan, 2015, p. 161). To date, institutional theory and its concept of legitimacy have rather taken a G-D logic perspective, as indicated by the lack of focus on value co-creation (e.g., Cousins and Robey, 2005; Dacin et al., 2007; Marton et al., 2017; Provan et al., 2015). By introducing the concept of legitimacy into S-D logic, it becomes clear that a specific actor, such as a mobility provider, needs to obtain legitimacy for its actions from the actors of its existing service ecosystem.

Based on these arguments, we assume that actors (government, industry associations, other mobility providers, etc.) constituting the service ecosystem of mobility providers can "impose significant pressures on [them] to justify their strategic actions" (Dacin et al., 2007, p. 171). This also influences their decision whether or not to conduct service-for-service exchange with D2D mobility integrators. Thus, the need of each mobility provider to legitimize its actions varies depending on the service ecosystems in which it is embedded. For example, the car-sharing company Car2go can draw on the existing legitimacy of its well established parent company Daimler AG, and hence does not face the same challenges as more recent start-ups such as Uber (Marton et al., 2017). Similarly, Dacin et al. (2007) argue that the need to legitimize actions depends on company-specific as well as environmental characteristics and can be a rationale for forming strategic alliances. In turn, given the frequent lack of service-for-service exchange between mobility providers and D2D mobility integrators (Albrecht and Ehmke, 2016), we expect that the other actors in their service ecosystem are not exerting sufficient legitimacy pressure on mobility providers to persuade them to cooperate with a D2D mobility integrator.

2.3 Possible Legitimacy Needs of Mobility Providers

In order to better understand the possible kinds of such pressure leading to legitimacy needs of mobility providers and, as a result, to service-for-service exchange with D2D mobility integrators, we draw on the institutional theory based framework of Dacin et al. (2007). This is also in line with the recommendation of Vargo and Lusch (2017) to further develop S-D logic with frameworks from outside marketing. Subsequently, we transfer the five types of legitimacy needs (market, relational, social, investment and alliance legitimacy), which, together or alone, motivate companies to enter a strategic alliance (Dacin et al., 2007), to the broader service ecosystem setting.

A mobility provider may conduct service-for-service exchange with a D2D mobility integrator in order to achieve *market legitimacy*, i.e., to establish or maintain the rights or qualifications necessary to continue doing business in its existing market or to enter into a new market, as in the case of D2D mobility. The need to gain market legitimacy is particularly high when a mobility provider lacks experience, a good reputation, or government approval in the eyes of its service ecosystem actors (customers, municipality, etc.). For example, after Uber was criticised for violating the German Passenger Transportation Act, it was banned in Germany (Seibt, 2016). In the positive sense, cooperation with a D2D mobility integrator perceived as an important actor to address the mobility-related challenges of cities could facilitate authorisation.

A mobility provider may also cooperate with a D2D mobility integrator in order to be perceived as an attractive potential member for a further service ecosystem (*relational legitimacy*). The mobility market is changing and its future is unclear (Münchner Kreis e.V., 2017; Schreieck et al., 2018). Numerous mobility providers with varied and sometimes innovative business models have entered the car- and ride-sharing market (Remane et al., 2016; Teubner and Flath, 2015), leading to high fragmentation. Simultaneously, market consolidation has already taken place in certain areas, such as German long-distance bus service (Breitinger, 2016). In addition, technical advances in autonomous driving are expected to further change the structure of the mobility market (Doll and Vetter, 2017). Against this background, it seems obvious that mobility providers are more likely cooperate with D2D mobility integrators when they expect to need to expand beyond their current service ecosystem and face high competition for attractive partners.

Another possible reason for cooperating is to gain *social legitimacy*. Our S-D logic perspective highlights that the service ecosystem of mobility providers includes not only possible additional mobility providers, but also a large number of other actors, such as national governments, municipalities, and, of course, citizens. Each of these actors evaluates the social acceptability of mobility providers' behaviour. Given the high number of problems caused by dominant private car usage, such as traffic congestion, a lack of parking (Arnott and Inci, 2006; Giuffrè et al., 2012) and air and noise pollution (Barth and Boriboonsomsin, 2008; Murphy and Delucchi, 1998), resulting in part from the inability of mobility providers to offer attractive mobility services, the need to enhance social legitimacy should be high. We argue that cooperation with a D2D mobility integrator can increase the attractiveness (Willing et al., 2017b) and social legitimacy of individual mobility services.

As already described in the introduction, the possibilities for providing mobility services have changed considerably in recent years due to the proliferation of smartphones and the emergence of new IT solutions, for example, for the provision of mobile tickets and real-time timetable data (Willing et al., 2017b). This development exerts enormous pressure on mobility providers to invest in order to meet the new requirements for vehicles, traffic infrastructure, and IT equipment (data platforms, sensors, etc.). While most service ecosystems actors acknowledge the necessity of investment in the long term, some financial actors, such as municipalities and parent companies, question the economic necessity for investment in the short term. For example, almost two thirds of the German experts surveyed in the study of Lasch et al. (2005) shared the expectation that electronic tickets will not provide economic benefits for mobility providers. In other words, there appears to be a lack of *investment legitimacy*. We argue that in order to legitimize their expenditures, mobility providers can enter a service-for-service exchange with a D2D mobility integrator. As Willing et al. (2017a) argue, a D2D mobility integrator, deploying advanced IT, can provide services leading to economic advantages for a mobility provider, such as recommendations for business area optimization or multi-mobility provider analyses.

Lastly, the aim to gain *alliance legitimacy*, which is “to establish endorsement for the alliance form itself” (Dacin et al., 2007, p. 178), can encourage companies to enter strategic alliances. For example, in the past, competing automobile manufacturers initially had to validate the appropriateness of a strategic alliance as a form of transaction in this sector. However, in the case of our study, there seems to be no necessity for such a traditional alliance legitimacy. As explained, most mobility providers already operate in service ecosystems and cooperate with other mobility providers directly or indirectly, for instance, through digital platforms. Today it is widely recognized that mobility services are sometimes in a competitive but more often in a complementary relationship (Willing et al., 2017a). We argue that mobility providers seek to establish a s*mart service integrator legitimacy* when conducting service-for-service exchange with D2D mobility integrators. Similar as the alliance was new for automobile manufacturers in the past, a cooperation with D2D mobility integrators aiming to provide individual, context-aware, and dynamic packaging of mobility services (Schulz et al., 2018) is new for mobility providers. Due to the high share of private car use in total mobility (TCI Röhling Transport Consulting International, 2016), the validation and legitimation of an intermediary role of D2D mobility integrators can contribute to ensuring the future business success of mobility providers.

In sum, based on the adapted framework, we assume that mobility providers may face five different kinds of pressure to legitimize themselves, and that cooperation with a D2D mobility integrator can provide the required legitimacy. In this study, we interview experts from German mobility providers to understand their lack of legitimacy needs and determine how that lack is shaped by the institutional arrangements of their current service ecosystem.

3 Methodology

3.1 Research Context

D2D mobility integrators as well as the scientific research on this topic are essentially limited to Europe, especially Germany (Willing et al., 2017b). The reasons for this could be pre-existing infrastructure, high public pressure, and legal conditions (Marx et al., 2015; Willing et al., 2017b). According to overviews of D2D mobility integrators operating in German-speaking Europe by Albrecht and Ehmke (2016) and Willing et al. (2017a; 2017b), all D2D mobility integrators are still in the start-up phase, illustrated by the limited functionality of their IT solution, for example, their lack of consideration of dynamic customer location data (Albrecht and Ehmke, 2016), and their failure to offer a booking or payment function (Willing et al., 2017a). The two most well-known examples are Moovel (Daimler AG) and Qixxit (Deutsche Bahn AG), which are both subsidiaries of established mobility companies. Simultaneously, publicly funded research projects like the Intermodal Mobility Assistance for Megacities (Masuch et al., 2013), Mobility Broker (Beutel et al., 2014a; 2014b), or WISETRIP (Aditjandra et al., 2009) envision D2D mobility. However, these projects have not yet been implemented or have been discontinued (Willing et al., 2017b).

We chose the German mobility market as the focus of this research because of its large size and unique structure. In 2015, German public transport, which is a collective of bus, subway, train, and tram transport, carried more than 10 billion passengers (Verband Deutscher Verkehrsunternehmen, 2016). In comparison, there were only a little over 4.5 billion passengers in Spain (Instituto Nacional de Estadística, 2016) and just over 2 billion passengers in Switzerland (in 2014) (Verband öffentlicher Verkehr, 2017). In addition, most German public transport companies belong to transport and tariff associations (TTAs), which are traditional service ecosystems. German TTAs used to consist solely of public transport companies, but now regional authorities, such as federal states, districts, or cities are frequently also shareholders (Reinhardt, 2012). This organizational specificity leads to a particularly high number of institutional arrangements, which may impede the legitimacy needs of mobility providers.

3.2 Data Collection and Analysis

Our data collection reflects the grouping of German public transport services into TTAs, which reflects the idea of mobility providers acting together in a service ecosystem. We used a theoretical sampling method (Flick, 2009; Glaser and Strauss, 1967) to choose twelve out of approximately 124 TTAs (Reinhardt, 2012; Wikipedia, 2016) typical in terms of the number of public transport companies involved and passengers per year. We excluded TTAs and their public transport companies that currently conduct service-for-service exchanges with an external D2D mobility integrator. We then chose between 2 and 12 of the public transport companies belonging to each TTA, depending on the size of the TTA, resulting in a selection of 57 public transport companies. In addition, we identified twelve further mobility providers, such as car-sharing and taxi companies, located in the geographical area of the selected TTAs. Because some of the car-sharing companies operate nationwide, and therefore in the geographical area of several TTAs, and because there are only a few bike-sharing companies, we randomly chose seven additional companies from the list of members of the association of German car-sharing providers (bsc Bundesverband CarSharing e.V., 2016) and from an updated bike-sharing market overview (Monheim et al., 2012; Wikipedia, 2017) to enhance our selection. In total, our selection comprises 76 mobility providers.

Since the managing director (MD) of the mobility providers is responsible for strategic decisions like whether to enter into a service ecosystem of D2D mobility integrators, we chose him/her as our contact person. Using a snowball sampling method (e.g., Su, 2013), we encouraged them to name further or more appropriate employees, such as department heads (HD). This approach using "highly knowledgeable informants" (Eisenhardt and Graebner, 2007, p. 28) helps us to reduce bias by image-conscious interviewees. We received thirteen interview confirmations, whereby in the case of MD8 and HD1 a joint interview appointment was agreed. Table 1 shows interviewees' demographic data and basic facts about their company.

<table>
<tr><th>ID</th><th>Role / Function</th><th>Gender</th><th>Years in position</th><th>Type of company</th><th>Number of employees</th><th>Passengers / bookings (in millions)</th><th>Revenue (EUR millions)</th></tr>
<tr><td>MD1</td><td>Managing director</td><td>Male</td><td>4</td><td>Car-sharing</td><td>17</td><td>0.02</td><td>2</td></tr>
<tr><td>MD2</td><td>Managing director</td><td>Male</td><td>2</td><td>Car-sharing</td><td>12</td><td>n.a.</td><td>n.a.</td></tr>
<tr><td>MD3</td><td>Managing director</td><td>Female</td><td>5</td><td>Car-sharing</td><td>180</td><td>1</td><td>14</td></tr>
<tr><td>MD4</td><td>Managing director</td><td>Male</td><td>12</td><td>Bus, tram</td><td>2,000</td><td>176</td><td>214</td></tr>
<tr><td>MD5</td><td>Managing director</td><td>Male</td><td>2</td><td>Train</td><td>300</td><td>11</td><td>80</td></tr>
<tr><td>MD6</td><td>Managing director</td><td>Male</td><td>7</td><td>Bike-sharing</td><td>3</td><td>0.03</td><td>0.3</td></tr>
<tr><td>MD7</td><td>Managing director</td><td>Male</td><td>18</td><td>Bus</td><td>19</td><td>1</td><td>n.a</td></tr>
<tr><td>MD8</td><td>Managing director</td><td>Female</td><td>2</td><td rowspan="2">Bus, tram</td><td rowspan="2">500</td><td rowspan="2">52</td><td rowspan="2">n.a</td></tr>
<tr><td>HD1</td><td>Head of department</td><td>Female</td><td>1</td></tr>
<tr><td>HD2</td><td>Head of department</td><td>Male</td><td>2</td><td>Bus, tram</td><td>700</td><td>43</td><td>27</td></tr>
<tr><td>HD3</td><td>Head of department</td><td>Male</td><td>2</td><td>Bus, tram</td><td>2,000</td><td>174</td><td>154</td></tr>
<tr><td>HD4</td><td>Head of department</td><td>Male</td><td>4</td><td>Car-sharing</td><td>n.a.</td><td>n.a.</td><td>n.a.</td></tr>
<tr><td>MM1</td><td>Marketing manager</td><td>Male</td><td>1</td><td>Car-sharing</td><td>n.a</td><td>n.a</td><td>3</td></tr>
<tr><td>OM1</td><td>Operations manager</td><td>Male</td><td>17</td><td>Bus</td><td>80</td><td>2.5</td><td>4</td></tr>
</table>

Table 1. Overview of interviewees and their companies.

Before the interviews were carried out, a semi-structured guideline (Yin, 2014), including questions about possible legitimacy needs of mobility providers, was developed. The questions comprised technical aspects like the currently used IT, and business-related topics, such as the involvement in current service ecosystems. The interviews took place between November 2016 and June 2017, and lasted on average 31 minutes. All interviews were recorded and transcribed (Flick, 2009). In addition, we followed a data triangulation approach (Flick, 2009; Miles et al., 2014) in order to enrich the interview data and to validate the statements of the interviewees. The secondary data (company reports, press releases, etc.) was collected through the websites and via publicly available data sources.

For data analysis, the software NVivo 10 was used. Following an iterative coding approach (Strauss and Corbin, 1998), one of the researchers scanned, categorized and coded the data. The initial coding schema was derived from the five types of legitimacy needs (market, relational, social, investment and smart service integrator legitimacy). In a second cycle of analysis, the codes of each entity were cross-related (Miles et al., 2014). During the entire coding process, the researchers constantly discussed the emerging coding with the aim to reduce the coding bias and to strengthen the internal validity. In addition, alternative explanations were checked to ensure the explanatory power of the results.

4 Analysis Results

We structure our results along the five legitimacy needs of mobility providers that may positively influence their decision to cooperate with D2D mobility integrators. We find that particularly car-sharing company representatives (MD1, MD2, MD3, MM1) believe that a D2D mobility integrator can help them to establish or maintain the rights or qualifications necessary to continue doing business in their existing car-sharing market or to enter into the D2D mobility market. This demonstrates a need for ***market legitimacy***. For example, MD2 stated that the company is *"still relatively new to the market and still relatively small (…). [And] it is, of course, a huge advantage if you can make a registration through a platform [of a D2D mobility integrator] once and try it [its car-sharing service] out without any additional hurdles"*.

By contrast, other interviewees voiced little need to gain market legitimacy through D2D mobility integrators. The car-sharing company of HD4 belongs to a regional municipal utility whose subsidiaries also provide bus and tram transport and operate a bike-sharing service. This company appears to already have the rights and qualifications (e.g., bus transport concessions, market experience, and reputation in the market) necessary to succeed in its car-sharing business and to enter into a regional limited D2D mobility market:

> *"We will never be represented there [on D2D mobility integrator platforms] because our market is not supraregional. Hence, we will deliberately distinguish ourselves by saying that we can offer something here in the city area identical to what Qixxit and Moovel can provide for a larger area." (HD4)*

Similarly, MD6 highlighted the regional character of its business activity as well as its focus on non-digital distribution channels as reasons why the emerging D2D mobility market is not particularly attractive for its bike-sharing company. Thus, no new rights or qualifications are needed:

> *"If we are requested for a destination that seems to make sense for us, we will of course place bikes there. (…). For this I don't need other platforms [e.g., from D2D mobility integrators] also not to win [end] customers online. You win them in cities like [names of the cities] better directly on site because it is always about the specific sector of tourism." (MD6)*

In contrast to this, HD2 attributes high relevance to the D2D mobility market at least in the future (*"we already see this as a market, but not in the current situation. Rather, in the long term, maybe in ten years"*). This appears to indicate that the need of some of the mobility providers to achieve market legitimacy is likely to increase in the future. In addition, there are interviewees for whom such a need is only partly existent, which means there are arguments for and against its existence. For instance, MD8 expects the D2D mobility market to divide into two parts:

> *"On my smartphone I have a separate section, called 'public transport apps'. There are eleven [apps] right now and this is okay for me. Because when I am in Berlin or in Cologne, I don't need an app that also shows me all transport connections from Munich. (…). But when I really make a longer trip, then I am quite interested in seeing the last mile of this travel chain as well. Hence, I have different needs, which probably have to be reflected in different apps." (MD8)*

Because MD8 estimated a much higher customer demand for D2D mobility services in a specific city, the necessity for service-for-service exchange with nationally operating D2D mobility integrators is limited. In summary, the proportion of mobility providers with an existent, partly existent, and non-existent need for market legitimacy is almost equal.

Secondly, mobility providers can enter into a service ecosystem of D2D mobility integrators in order to gain ***relational legitimacy***, i.e., because they wish to be perceived as an attractive potential member for further service ecosystems. This presupposes that the D2D mobility integrator and the actors of its service ecosystem are considered sufficiently attractive to increase their own attractiveness. However, almost all interviewees question this. For example, HD3 argued that, in the current state of flux, an evaluation of the attractiveness and subsequent selection of appropriate D2D mobility integrators is impossible:

> *"But it [a D2D mobility integrator] could also be a competitor. This is still an unclear situation that depends on how these third parties, as well as we ourselves, will develop over the next few weeks, months, and years. I don't think it is possible to final answer the question of competition or partnership today." (HD3)*

HD4 added that the strong dependency on the respective parent company represents a difficulty to identify the D2D mobility integrator which will succeed on the market:

> *"Moovel (…) will not integrate certain competitors [e.g., from Car2go, the car-sharing company of Daimler AG] because of their owners. Thus, two or three apps will remain on the market and then you can evaluate their quality; how well do the D2D trips work?" (HD4)*

In addition, the interviewees (MD2, MD5, MD8, OM1) expected negative economic consequences for their current business. Resulting from the fact that the parent company is often a traditional automobile manufacturer or a direct competitor, as in the case of the Deutsche Bahn AG, they assumed an over-reaching and non-neutral creation of D2D mobility services. For instance, MD2 illustrated:

> *"Everyone is asking the big question: What is Daimler AG's intention? Why does the Daimler AG want to do this? There must be something wrong. They are probably trying to push or pull us in one direction. Because it is an automobile company and not a public provider there is a bit of skepticism." (MD2)*

The legal affiliation of a D2D mobility integrator to an automobile manufacturer also reduces its attractiveness in the eyes of the car-sharing companies controlled by competing automobile manufacturers. In the case of MM1, whose car-sharing company belongs to one of the largest European automobile manufacturers, competitive thinking closely ties its company to the superordinate service ecosystem of the parent company:

> *"All mobility platforms are somehow in the hands of automobile companies or in the process of being purchased by automobile or mobility companies. For example, Free2Move – Groupe PSA, Moovel – Daimler AG, (…), Urbi is about to be purchased. (…). Everyone is buying in the general store of mobility start-ups what s/he still needs for its portfolio"* and *"Everyone hopes that his or her acquisitions are suitable to capture the market." (MM1)*

The observation that an embeddedness in an existing service ecosystem contributes to making D2D mobility integrators unattractive is also emphasized by MD8. Its TTA can already now offer an integrated ticket for its local bus and tram companies, which, for example, Qixxit cannot do. Moreover, MM1 implies that further mobility platforms – the two additionally mentioned do not provide D2D mobility, but only allow access to car-sharing services offered by different companies – are regarded as equally attractive as those of D2D mobility integrators.

Another reason for mobility providers to engage in service-for-service exchange with D2D mobility integrators is to meet ***social legitimacy*** needs. Different actors from its service ecosystem, such as the national government, municipalities, or citizens, evaluate whether its current behaviour is acceptable. In the case of the car-sharing companies, the interviewees (MD1, MD2, MD3, MM1) did not perceived such legitimacy pressure, which could be due to the fact that these companies use environmentally friendly cars (e.g., with electric drive). In contrast, as exemplified by the following quotations, there are more differentiated results concerning the other mobility providers. As HD3 stated:

> *"The question at the moment is: Can it [a D2D mobility integrator] ensure that access to in our view meaningful mobility, with regard to urban development, [and] ecological development, can be further facilitated?"*, whereby s/he more precisely specified 'in our view' as *"in the interest of cities, associations, politics, etc.." (HD3)*

It becomes clear that HD3 currently perceived high pressure to legitimize its behaviour in light of problems caused by the large share of private car use, such as traffic congestion and air and noise pollution. An obvious explanation for this result is that three cities are shareholders of this mobility provider. However, as in the cases of MD7 (*"there is no specification at the moment"*) and OM1 ("*we [the members of its TTA] are rather in the phase where we are making observations now and will decide at a later point in time"*) there are also regional authorities, acting as shareholders of a TTA, which are not exerting sufficient legitimacy pressure on public transport companies to persuade them to cooperate with D2D mobility integrators.

None of the mobility providers expressed the need to gain ***investment legitimacy***. This is partly because, although the mobility market has changed rapidly due to technical advances, the mobility providers obtained approval for cost-intensive investments in new equipment as, for instance, necessary for the provision of real-time timetable data and mobile tickets. This is reflected by MD4:

> *"The need for this development and for digitalization (...) is seen in any case and it is also understood that this costs money. I observe that we are already dealing with understanding owners familiar with the issue. On the contrary, I am aware of cases of other municipal transport companies which, if they do not address this development, get reprimanded." (MD4)*

Similarly, OM1 is stating that its owners are relatively generous and *"also willing to spend money, where a corresponding revenue does not immediately result and everything cannot be realized in a cost-covering way"*. Nevertheless, it is somewhat surprising that this applies equally to private and public mobility providers. In some cases (MD2, MD6, MD8, HD4), we could even observe that the desire to act in the interests of owners leads to a rejection of D2D mobility integrators. As MD2 stated:

> *"At the end, the customer looks at the Moovel-App (...), i.e., to what extent does my brand erode? (...). But if I want to continue to operate this [its mobility service] as an independent brand, the platform [of a D2D mobility integrator] is already a threat. (...). It is also a question of money. In group thinking, we put a few hundred million euros into a brand like [name of the brand], which thus has a brand value. The brand value is also shown on the balance sheet. Now, if I say that I will forego the brand, first of all, I will lose a large share of goodwill on the balance sheet. Why should I give it away?" (MD2)*

Such concerns especially existed in cases in which the respective mobility provider is embedded in a larger service ecosystem of an automobile manufacturer or a local municipal utility.

Lastly, our analysis showed that most of the mobility providers have no need to build up a ***smart service integrator legitimacy*** with the help of D2D mobility integrators currently operating in the market. This is caused by actors that are present in their service ecosystem, such as a subsidiary of the federal state (HD2), a sector association (MD5), a TTA (MD4, MD8, HD3), a parent company (HD4), or another mobility provider (MM1), which integrate the respective mobility provider into their own D2D mobility project. In this way, these mobility providers contribute – at least in the long term – to the legitimation of the new type of cooperation and thus to the intermediary role of D2D mobility integrators. However, as can be seen from the quotation of HD2, the involvement is not always welcome:

> *"We are participating in a development carried out by the [name of the subsidiary of the federal state]. An app has been developed (...) and we are more or less inevitably involved due to the fact that we operate mobile ticketing. The mobile ticketing becomes part of these mobility chains." (HD2)*

One reason for this reluctance could be the low success rates of public funded D2D mobility projects, as described above. Besides this political directive, the close ties to the parent company and its service ecosystem can positively influence the choice of a D2D mobility project. As MD5 reported, there is a financial obligation of its parent company to the sector association, called 'Verband Deutscher Verkehrsunternehmen' (VDV), leading to a participation (*"we contribute to the financing of this VDV platform [a D2D mobility project] via the parent company"*). This D2D mobility project will satisfy its need to establish a legitimacy for smart service integrators, making service-for-service exchange with available D2D mobility integrators unnecessary:

> *"Our goal is to present a comprehensive [D2D] mobility platform through the 'Mobility-Inside' solution from the VDV. We will participate in this one, but not in more than one because I don't see the point and purpose of it." (MD5)*

Figure 2 summarizes the existing legitimacy needs of the mobility providers interviewed. Each of them perceived at least one of the five types of needs to gain legitimacy. However, in contrast to the argumentation for strategic alliances (Dacin et al., 2007), a single legitimacy need is not sufficient to motivate them to enter into the service ecosystem of a D2D mobility integrator. A closer look at the results shows that while the car-sharing companies are particularly interested in gaining market legitimacy, the other mobility providers aim to achieve social and smart service integrator legitimacy.

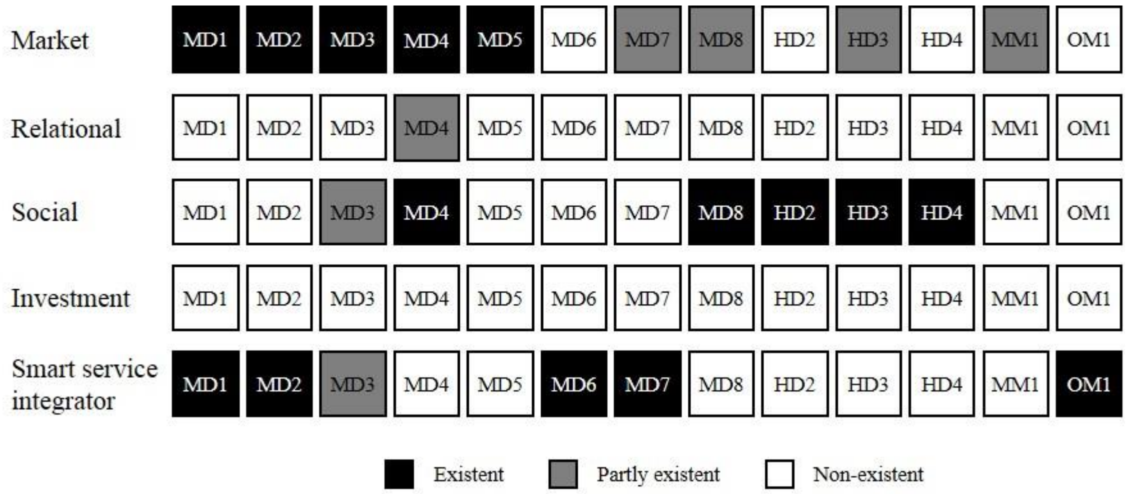

Figure 2. Legitimacy needs of German mobility providers.

5 Discussion and Conclusion

Prior to outlining avenues for future research, we discuss the major findings and implications of our study. The primary aim of this study was to enhance our understanding on D2D mobility integrators and their difficulties to convince mobility providers to cooperate. Currently, the need for scientific research on emerging D2D mobility integrators in general (Albrecht and Ehmke, 2016; Willing et al., 2017a; 2017b), and this specific research topic in particular (Schulz et al., 2018), is great. We contribute to closing this gap by conducting an exploratory study in the German mobility market.

For the theoretical foundation of our study, we linked the concept of service ecosystem, which follows from S-D logic (Vargo and Lusch, 2004; 2016; 2017), with that of legitimacy stemming from the institutional theory (Dacin et al., 2007; Mignerat and Rivard, 2009; Suchman, 1995). Thus, we follow the call of Vargo and Lusch (2017) to further develop S-D logic using frameworks and models outside marketing. We initially illustrated that in the case of D2D mobility integrators, which aim to offer smart D2D mobility, the assumptions of S-D logic are fulfilled. In particular, we showed that all actors, including the customers, were engaged in service-for-service exchange (Vargo and Lusch, 2016; 2017). For example, customers have to provide their GPS data to D2D mobility integrators.

Secondly, we provide evidence that the introduction of the concept of legitimacy into S-D logic can help us to better understand the low level of cooperation between mobility providers and D2D mobility integrators. According to S-D logic (Akaka et al., 2013; Koskela-Huotari et al., 2016a; Vargo and Lusch, 2017; Vargo et al., 2015), institutions and institutional arrangements are the coordination mechanism within and between service ecosystems, which can also constrain service-for-service exchange if they are incompatible. While Koskela-Huotari et al. (2016a) put forward that necessary adjustments in a specific service ecosystem, such as that of a D2D mobility integrator, can be initiated by the inclusion of one or more new actors, the literature does not provide an explanation how institutional arrangements of another service ecosystem, as in the case of a mobility provider, can prevent such a step. We shed light on this issue by drawing on an adapted framework of Dacin et al. (2007), which proposed five types of legitimacy needs leading a company to enter a strategic alliance.

Hence, thirdly, we contribute to institutional theory (Dacin et al., 2007; Scott, 2008) by adapting the five types of legitimacy needs (market, relational, social, investment, and alliance legitimacy) to the broader service ecosystem context, more specifically, D2D mobility integrators. In particular, we completely revised alliance legitimacy, changing its name to *smart service integrator legitimacy*, to cover the emerging kind of cooperation enabled by D2D mobility integrators. As result of this, and with the choice of D2D mobility integrators as object of investigation in general, we also address the criticism of S-D logic to rarely consider IT, as put forward by Breidbach and Maglio (2016).

In addition, based on our exploratory study in the German mobility market, which complements the currently predominant S-D logic publications without empirical evidence (see Giesbrecht et al., 2017), we can provide numerous practical implications. For example, our results show that in order to achieve cooperation, D2D mobility integrators need to position itself more strongly as a source for legitimation. The corresponding strategies, however, differ depending on the type of mobility providers. Whereas car-sharing companies need to gain market legitimacy, most of the analysed bus, train, and tram companies, due to existing institutional arrangements which form a kind of regional monopoly (in particular, their relation to their parent company, as in the case of municipal utilities, and the TTA), see no need for cooperating to continue their business successfully. Nonetheless, D2D mobility integrators might contribute to increasing demand even in such a closed market. As Willing et al. (2017a) illustrated, D2D mobility integrators have extensive possibilities to use business analytics that exceed those of an individual or a small group of mobility providers. Based on this, they can, for example, coordinate car-sharing and bus services (positioning of stations, etc.) and thus increase their common attractiveness compared to private car use. In the case of higher market demand, it is also to expect that the management is increasingly giving up its concerns with regard to the erosion of the brand in order to reap the additional revenues for the owners.

Another practical implication results from our observation that mobility providers do not find the existing D2D mobility integrators attractive enough because their competitors occupy a central position in the service ecosystem. This is a bit paradoxical, as obviously more suitable public funded D2D mobility projects have also been discontinued or have yet to be implemented (Willing et al., 2017b). Hence, we call for pursuing these projects with more effort to contribute quickly to solving the mobility-related challenges of cities. In particular, we opt for a higher-order project that links the numerous emerging locally operating D2D mobility integrators.

Future research can build on this recommendation and investigate the failure of public funded D2D mobility projects. In addition, even though conducting an exploratory study is a good starting point for understudied research topics like D2D mobility integrators it has some limitations that must be addressed by future work. Further qualitative and quantitative studies are necessary to ensure validity of the results. Furthermore, although the selection of the German mobility market seems suitable (Marx et al., 2015; Willing et al., 2017b), mobility providers from additional countries also should be analysed to check the transferability of the results.

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References

Aditjandra, P. T., J. D. Nelson, and S. D. Wright (2009). "A Multi-Modal International Journey Planning System: A Case Study of WISETRIP." In: *Proceedings of the World Congress and Exhibition on Intelligent Transport Systems*. Stockholm.

Ahuja, G. (2000). "The Duality of Collaboration: Inducements and Opportunities in the Formation of Interfirm Linkages." *Strategic Management Journal* 21 (3), pp. 317-343.

Akaka, M. A., S. L. Vargo, and R. F. Lusch (2013). "The Complexity of Context: A Service Ecosystems Approach for International Marketing." *Journal of International Marketing* 21 (4), pp. 1-20.

Albrecht, L. and J. F. Ehmke (2016). "Innovative Services in der Mobilitätsbranche: Eine Marktanalyse Multimodaler Mobilitätsmanager." In: *Proceedings of the Multikonferenz Wirtschaftsinformatik*. Ilmenau.

Alt, R. (2016). "Electronic Markets on Customer-Orientation." *Electronic Markets* 26 (3), pp. 195-198.

Arnott, R. and E. Inci (2006). "An Integrated Model of Downtown Parking and Traffic Congestion." *Journal of Urban Economics* 60 (3), pp. 418-442.

Arthur, W. B. (2009). *The Nature of Technology: What It Is and How It Evolves*. New York: Free Press.

Avgerou, C. (2000). "IT and Organizational Change: An Institutionalist Perspective." *Information Technology & People* 13 (4), pp. 234-262.

Backhouse, J., C. W. Hsu, and L. Silva (2006). "Circuits of Power in Creating De Jure Standards: Shaping an International Information Systems Security Standard." *MIS Quarterly* 30, pp. 413-438.

Barney, J. B. and W. Hesterly (2006). "Organizational Economics: Understanding the Relationship between Organizations and Economic Analysis." In: *The SAGE Handbook of Organization Studies*. Ed. by S. R. Clegg, C. Hardy, T. B. Lawrence, and W. R. Nord. SAGE Publications. London. pp. 111-148.

Barth, M. and K. Boriboonsomsin (2008). "Real-World Carbon Dioxide Impacts of Traffic Congestion." *Transportation Research Record: Journal of the Transportation Research Board* 2058, pp. 163-171.

Baum, J. A. C. and C. Oliver (1991). "Institutional Linkages and Organizational Mortality." *Administrative Science Quarterly* 36 (2), pp. 187-218.

Beirão, G., L. Patrício, and R. P. Fisk (2017). "Value Cocreation in Service Ecosystems: Investigating Health Care at the Micro, Meso, and Macro Levels." *Journal of Service Management* 28 (2), pp. 227-249.

Beutel, M. C., S. Gökay, W. Kluth, K.-H. Krempels, C. Samsel, and C. Terwelp (2014a). "Product Oriented Integration of Heterogeneous Mobility Services." In: *Proceedings of the International Conference on Intelligent Transportation Systems*. Qingdao.

Beutel, M. C., C. Samsel, M. Mensing, and K.-H. Krempels (2014b). "Business Model Framework to Provide Heterogeneous Mobility Services on Virtual Markets." In: *Proceedings of the International Conference on e-Business*. Vienna.

Breidbach, C. F. and P. P. Maglio (2016). "Technology-Enabled Value Co-Creation: An Empirical Analysis of Actors, Resources, and Practices." *Industrial Marketing Management* 56, pp. 73–85.

Breitinger, M. (2016). *Ende eines harten Kampfes*. URL: http://www.zeit.de/mobilitaet/2016-08/fernbusmarkt-flixbus-postbus-konkurrenz-monopol-preise (visited on 2017-10-31).

bsc Bundesverband CarSharing e.V. (2016). *Mitglieder*. URL: https://carsharing.de/verband/wir-ueber-uns/mitglieder (visited on 2016-08-24).

Bundesministerium für Verkehr und digitale Infrastruktur (2017). *Carsharing: BMVI gibt Startschuss*. URL: https://www.bmvi.de/SharedDocs/DE/Artikel/LA/carsharing-gesetz.html (visited on 2017-10-13).

Chandler, J. D. and S. L. Vargo (2011). "Contextualization and Value-in-Context: How Context Frames Exchange." *Marketing Theory* 11 (1), pp. 35-49.

Cho, S. and L. Mathiassen (2007). "The Role of Industry Infrastructure in Telehealth Innovations: A Multi-Level Analysis of a Telestroke Program." *European Journal of Information Systems* 16 (6), pp. 738-750.

Consulting4Drive and BSL Transportation Consultants (2015). "Intermodale Verkehrskonzepte in Deutschland".

Cousins, K. C. and D. Robey (2005). "The Social Shaping of Electronic Metals Exchanges: An Institutional Theory Perspective." *Information Technology & People* 18 (3), pp. 212-229.

Dacin, M. T., C. Oliver, and J. P. Roy (2007). "The Legitimacy of Strategic Alliances: An Institutional Perspective." *Strategic Management Journal* 28 (2), pp. 169-187.

DiMaggio, P. J. and W. W. Powell (1983). "The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields." *American Sociological Review* 48 (2), pp. 147-160.

Doll, N. and P. Vetter (2017). *Wo sich Uber und Co. noch besonders schwertun*. URL: https://www.welt.de/wirtschaft/article168348901/Wo-sich-Uber-und-Co-noch-besonders-schwertun.html (visited on 2017-10-31).

Eisenhardt, K. M. and M. E. Graebner (2007). "Theory Building from Cases: Opportunities and Challenges." *Academy of Management Journal* 50 (1), pp. 25-32.

Eisenhardt, K. M. and C. B. Schoonhoven (1996). "Resource-Based View of Strategic Alliance Formation: Strategic and Social Effects in Entrepreneurial Firms." *Organization Science* 7 (2), pp. 136-150.

Firnkorn, J. and M. Müller (2011). "What Will Be the Environmental Effects of New Free-Floating Car-Sharing Systems? The Case of Car2go in Ulm." *Ecological Economics* 70 (8), pp. 1519-1528.

Flick, U. (2009). *An Introduction to Qualitative Research*. London: SAGE Publications.

Frow, P., J. R. McColl-Kennedy, and A. Payne (2016). "Co-Creation Practices: Their Role in Shaping a Health Care Ecosystem." *Industrial Marketing Management* 56, pp. 24-39.

Giesbrecht, T., G. Schwabe, and B. Schenk (2017). "Service Encounter Thinklets: How to Empower Service Agents to Put Value Co-Creation into Practice." *Information Systems Journal* 27 (2), pp. 171-196.

Giuffrè, T., S. M. Siniscalchi, and G. Tesoriere (2012). "A Novel Architecture of Parking Management for Smart Cities." *Procedia-Social and Behavioral Sciences* 53, pp. 16-28.

Glaser, B. G. and A. L. Strauss (1967). *The Discovery of Grounded Theory: Strategies for Qualitative Research*. New York: Aldine de Gruyter.

Hearn, G., S. Roodhouse, and J. Blakey (2007). "From Value Chain to Value Creating Ecology: Implications for Creative Industries Development Policy." *International Journal of Cultural Policy* 13 (4), pp. 419-436.

Hildebrandt, B., A. Hanelt, E. Piccinini, L. M. Kolbe, and T. Nierobisch (2015). "The Value of IS in Business Model Innovation for Sustainable Mobility Services - the Case of Carsharing." In: *Proceedings of the International Conference on Wirtschaftsinformatik*. Osnabrück.

Instituto Nacional de Estadística (2016). "Passenger Transport Statistics."

Ireland, R. D., M. A. Hitt, and D. Vaidyanath (2002). "Alliance Management as a Source of Competitive Advantage." *Journal of Management* 28 (3), pp. 413-446.

Jarvis, W., W. Halvorson, S. Sadeque, and S. Johnston (2014). "A Large Class Engagement (LCE) Model Based on Service-Dominant Logic (SDL) and Flipped Classrooms." *Education Research and Perspectives* 41, pp. 1-24.

Kaganer, E., S. D. Pawlowski, and S. Wiley-Patton (2010). "Building Legitimacy for IT Innovations: The Case of Computerized Physician Order Entry Systems." *Journal of the Association for Information Systems* 11 (1), pp. 1-33.

Kale, P., H. Singh, and H. Perlmutter (2000). "Learning and Protection of Proprietary Assets in Strategic Alliances: Building Relational Capital." *Strategic Management Journal* 21 (3), pp. 217-237.

Kenis, P. and D. Knoke (2002). "How Organizational Field Networks Shape Interorganizational Tie-Formation Rates." *Academy of Management Review* 27 (2), pp. 275-293.

Khalifa, M. and R. M. Davison (2006). "SME Adoption of IT: The Case of Electronic Trading Systems." *IEEE Transactions on Engineering Management* 53 (2), pp. 275-284.

Koskela-Huotari, K., B. Edvardsson, J. M. Jonas, D. Sörhammar, and L. Witell (2016a). "Innovation in Service Ecosystems—Breaking, Making, and Maintaining Institutionalized Rules of Resource Integration." *Journal of Business Research* 69 (8), pp. 2964-2971.

Koskela-Huotari, K., J. Siltaloppi, and S. L. Vargo (2016b). "Designing Institutional Complexity to Enable Innovation in Service Ecosystems." In: *Proceedings of the International Conference on System Sciences*. Hawaii

Lai, Y.-W., C. Hsu, and Y.-J. Joung (2014). "A Case Study on Cloud Computing Strategy of a Telecom Company in Taiwan: An Organizational Legitimacy Perspective." In: *Proceedings of the Pacific Asia Conference on Information Systems*. Chengdu.

Lasch, R., A. Lemke, R. Jugelt, G. Probst, N. Wagener, and J. Winckler (2005). "Endbericht zur Delphi-Studie "ÖPNV-Markt der Zukunft". Berlin.

Lawrence, T. B. and R. Suddaby (2006). "Institutions and Institutional Work." In: *The SAGE Handbook of Organizational Studies*. Ed. by S. R. Clegg, C. Hardy, T. B. Lawrence, and W. R. Nord. SAGE Publications. London. pp. 215-254.

Lusch, R. F. and S. Nambisan (2015). "Service Innovation: A Service-Dominant Logic Perspective." *MIS Quarterly* 39 (1), pp. 155-175.

Lyytinen, K., M. Newman, and A.-R. A. Al-Muharfi (2009). "Institutionalizing Enterprise Resource Planning in the Saudi Steel Industry: A Punctuated Socio-Technical Analysis." *Journal of Information Technology* 24 (4), pp. 286-304.

Maglio, P. P., S. L. Vargo, N. Caswell, and J. Spohrer (2009). "The Service System Is the Basis Abstraction of Service Science." *Information Systems and e-Business Management* 7 (4), pp. 395-406.

Mangan, A. and S. Kelly (2009). "Information Systems and the Allure of Organisational Integration: A Cautionary Tale from the Irish Financial Services Sector." *European Journal of Information Systems* 18 (1), pp. 66-78.

Marton, A., I. Constantiou, and G. Lagoudakos (2017). "Openness and Legitimacy Building in the Sharing Economy: An Exploratory Case Study about CouchSurfing." In: *Proceedings of the Hawaii International Conference on System Sciences*. Hawaii.

Marx, R., A. M. de Mello, M. Zilbovicius, and F. F. de Lara (2015). "Spatial Contexts and Firm Strategies: Applying the Multilevel Perspective to Sustainable Urban Mobility Transitions in Brazil." *Journal of Cleaner Production* 108, pp. 1092-1104.

Masuch, N., M. Lützenberger, and J. Keiser (2013). "An Open Extensible Platform for Intermodal Mobility Assistance." *Procedia Computer Science* 19, pp. 396-403.

Meyer, J. W. and B. Rowan (1977). "Institutionalized Organizations: Formal Structure as Myth and Ceremony." *American Journal of Sociology* 83 (2), pp. 340-363.

Mignerat, M. and S. Rivard (2009). "Positioning the Institutional Perspective in Information Systems Research." *Journal of Information Technology* 24 (4), pp. 369-391.

Miles, M. B., A. M. Huberman, and J. Saldaña (2014). *Qualitative Data Analysis: A Methods Sourcebook*. Los Angeles: SAGE Publications.

Miscione, G. (2007). "Telemedicine in the Upper Amazon: Interplay with Local Health Care Practices." *MIS Quarterly* 31 (2), pp. 403-425.

Monheim, H., C. Muschwitz, J. Reimann, and M. Streng (2012). *Fahrradverleihsysteme in Deutschland: Relevanz, Potenziale und Zukunft öffentlicher Leihfahrräder*. Köln: KSV-Verlag.

Münchner Kreis e.V. (2017). "Mobility. Fulfilment. System: On the Future of Mobility 2025+."

Murphy, J. and M. A. Delucchi (1998). "A Review of the Literature on the Social Cost of Motor Vehicle Use in the United States." *Journal of Transportation and Statistics* 1 (1), pp. 15-42.

Nielsen, J. A., L. Mathiassen, and S. Newell (2014). "Theorization and Translation in Information Technology Institutionalization: Evidence from Danish Home Care." *MIS Quarterly* 38 (1), pp. 165-186.

Nischak, F., A. Hanelt, and L. M. Kolbe (2017). "Unraveling the Interaction of Information Systems and Ecosystems - a Comprehensive Classification of Literature." In: *Proceedings of the International Conference on Information Systems*. Seoul.

North, D. C. (1990). *Institutions, Institutional Change and Economic Performance*. Cambridge University Press.

Oliver, C. (1990). "Determinants of Interorganizational Relationships: Integration and Future Directions." *Academy of Management Review* 15 (2), pp. 241-265.

Provan, K. G., P. Kenis, and S. E. Human (2015). "Legitimacy Building in Organizational Networks." In: *Big Ideas in Collaborative Public Management.* Ed. by L. B. Bingham, and O. L. Rosemary. Routledge. New York. pp. 121-137.

Reinhardt, W. (2012). *Öffentlicher Personennahverkehr: Technik - Rechtliche und Betriebswirtschaftliche Grundlagen*. Wiesbaden: Vieweg+Teubner Verlag.

Remane, G., R. C. Nickerson, A. Hanelt, J. F. Tesch, and L. M. Kolbe (2016). "A Taxonomy of Carsharing Business Models." In: *Proceedings of the International Conference on Information Systems*. Dublin.

Schmidt-Rauch, S. and G. Schwabe (2014). "Designing for Mobile Value Co-Creation—the Case of Travel Counselling." *Electronic Markets* 24 (1), pp. 5-17.

Schreieck, M., C. Pflügler, D. S. Setzke, M. Wiesche, and H. Krcmar (2018). "Improving Urban Transportation: An Open Platform for Digital Mobility Services." In: *Digital Marketplaces*

Unleashed. Ed. by C. Linnhoff-Popien, R. Schneider, and M. Zaddach. Springer. Berlin. pp. 479-489.

Schultze, U. and A. D. Bhappu (2017). "Organization-Sponsored Sharing Platforms: Managing the Dialectics of Conflicting Institutional Logics." In: *Proceedings of the International Conference on Information Systems*. Seoul.

Schulz, T., H. Gewald, and M. Böhm (2018). "The Long and Winding Road to Smart Integration of Door-to-Door Mobility Services: An Analysis of the Hindering Influence of Intra-Role Conflicts." In: *Proceedings of the European Conference on Information Systems*. Portsmouth.

Scott, W. R. (2008). *Institutions and Organizations: Ideas and Interests*. Los Angeles: SAGE Publications.

Seibt, P. (2016). *Taxidienst: Uber verliert vor Gericht - und nun*? URL: http://www.spiegel.de/wirtschaft/unternehmen/fahrdienst-uber-uberpop-bleibt-in-deutschland-verboten-a-1096768.html (visited on 2017-10-31).

Shaheen, S. A., S. Guzman, and H. Zhang (2010). "Bikesharing in Europe, the Americas, and Asia. Past, Present, and Future." *Transportation Research Record: Journal of the Transportation Research Board* 2143, pp. 159-167.

Sia, S. K. and C. Soh (2007). "An Assessment of Package–Organisation Misalignment: Institutional and Ontological Structures." *European Journal of Information Systems* 16 (5), pp. 568-583.

Spohrer, J., S. L. Vargo, N. Caswell, and P. P. Maglio (2008). "The Service System Is the Basic Abstraction of Service Science." In: *Proceedings of the International Conference on System Sciences*. Hawaii.

Spohrer, J. C. and P. P. Maglio (2010). "Toward a Science of Service Systems: Value and Symbols." In: *Handbook of Service Science.* Ed. by P. P. Maglio, C. A. Kieliszewski, and J. C. Spohrer. Springer. Boston. pp. 157-194.

Storbacka, K., R. J. Brodie, T. Böhmann, P. P. Maglio, and S. Nenonen (2016). "Actor Engagement as a Microfoundation for Value Co-Creation." *Journal of Business Research* 69 (8), pp. 3008-3017.

Strauss, A. L. and J. M. Corbin (1998). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory.* Thousand Oaks: SAGE Publications.

Su, N. (2011). "Emergence of Cloud Computing: An Institutional Innovation Perspective." In: *Proceedings of the International Conference on Information Systems*. Shanghai.

Su, N. (2013). "Internationalization Strategies of Chinese IT Service Suppliers." *MIS Quarterly* 37 (1), pp. 175-200.

Suchman, M. C. (1995). "Managing Legitimacy: Strategic and Institutional Approaches." *Academy of Management Review* 20 (3), pp. 571-610.

TCI Röhling Transport Consulting International (2016). *Gleitende Mittelfristprognose für den Personen- und Güterverkehr*. Waldkirch.

Teo, H. H., K. K. Wei, and I. Benbasat (2003). "Predicting Intention to Adopt Interorganizational Linkages: An Institutional Perspective." *MIS Quarterly* 27 (1), pp. 19-49.

Teubner, T. and C. M. Flath (2015). "The Economics of Multi-Hop Ride Sharing. Creating New Mobility Networks through IS." *Business & Information Systems Engineering* 57 (5), pp. 311-324.

United Nations Department of Economic and Social Affairs (2015). "World Urbanization Prospects."

Vargo, S. L. and R. F. Lusch (2004). "Evolving to a New Dominant Logic for Marketing." *Journal of Marketing* 68 (1), pp. 1-17.

Vargo, S. L. and R. F. Lusch (2016). "Institutions and Axioms: An Extension and Update of Service-Dominant Logic." *Journal of the Academy of Marketing Science* 44 (1), pp. 5-23.

Vargo, S. L. and R. F. Lusch (2017). "Service-Dominant Logic 2025." *International Journal of Research in Marketing* 34 (1), pp. 46-67.

Vargo, S. L., P. P. Maglio, and M. A. Akaka (2008). "On Value and Value Co-Creation: A Service Systems and Service Logic Perspective." *European Management Journal* 26 (3), pp. 145-152.

Vargo, S. L., H. Wieland, and M. A. Akaka (2015). "Innovation through Institutionalization: A Service Ecosystems Perspective." *Industrial Marketing Management* 44, pp. 63-72.

Verband Deutscher Verkehrsunternehmen (2016). "2015 Statistik."

Verband öffentlicher Verkehr (2017). "Facts & Figures. Swiss Public Transport 2016/2017."

Wikipedia (2016). *Liste deutscher Tarif- und Verkehrsverbünde*. URL: https://de.wikipedia.org/wiki/Liste_deutscher_Tarif-_und_Verkehrsverb%C3%BCnde (visited on 2016-09-23).

Wikipedia (2017). *Fahrradverleihsystem*. URL: https://de.wikipedia.org/wiki/Fahrradverleihsystem (visited on 2017-06-06).

Willing, C., T. Brandt, and D. Neumann (2017a). "Electronic Mobility Market Platforms – a Review of the Current State and Applications of Business Analytics." *Electronic Markets* 27 (3), pp. 267-282.

Willing, C., T. Brandt, and D. Neumann (2017b). "Intermodal Mobility." *Business & Information Systems Engineering* 59 (3), pp. 173-179.

Winter, A., R. Alt, J. Ehmke, R. Haux, W. Ludwig, D. Mattfeld, A. Oberweis, and B. Paech (2012). "Manifest–Kundeninduzierte Orchestrierung Komplexer Dienstleistungen." *Informatik-Spektrum* 35 (6), pp. 399-408.

Yin, R. K. (2014). *Case Study Research: Design and Methods*. 5th Edition. Thousand Oaks: SAGE Publications.

Appendix F. How Countervailing Power Affects Value Co-Creation among Service Providers: A Comparison of the Travel and Mobility Sectors (P5)

How Countervailing Power Affects Value Co-Creation among Service Providers: A Comparison of the Travel and Mobility Sectors

Completed Research Paper

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Abstract

Customers often have complex needs that cannot be met by a single service provider. Service integrators and service providers can use information technology to establish service ecosystems in order to provide customers an all-in-one solution. In this paper, we examine why hotel organizations are more willing to engage in value co-creation with service integrators than public transport organizations. We take the service-dominant logic perspective, augmented by the concept of (countervailing) power. Interviews with representatives from 26 German hotel and public transport organizations reveal a trade-off between greater satisfaction of customer needs and a potential loss of power. In contrast to hotel organizations, the service ecosystems of public transport organizations are characterized by institutional arrangements that restrict their price and place policies, and thus negatively affect their ability to develop and maintain countervailing power. Practitioners can apply our findings to design beneficial institutional arrangements and thus facilitate value co-creation.

Keywords: Power Theory, Service-Dominant Logic, Service Integrators, Smart Mobility.

Introduction

Technical progress has revolutionized every sectors of the global economy, disrupting previously successful business models and attracting new players. For example, fueled by widespread Internet access (Andrés et al. 2010), service integrators in the **travel sector** (e.g., Booking Holdings and Expedia Group, Inc.) now compete with classic brick-and-mortar travel agencies. These service integrators enable travel-related services such as flights, hotels and car rentals to be bundled through a website (Schulz et al. 2018). Bundling reflects a stronger customer orientation and enables service integrators to satisfy customers' complex travel needs better than a single service provider can. By drawing on domain-specific knowledge, the service integrators establish a service ecosystem, which typically includes a significant number of service providers, which make it easier for customers to select and combine services in advance of a trip. Mirroring this development, service integrators are also finding their footing in other sectors, such as education, finance, health, and mobility (Alt et al. 2019).

As digitalization advances, the service platforms (e.g., a website or an app) of service integrators are becoming 'smarter' (Schulz et al. 2018). According to Gretzel et al. (2015, p. 179), 'smart' describes "technological, economic and social developments fueled by technologies that rely on sensors, big data, open data, new ways of connectivity and exchange of information (e.g., Internet of Things, RFID, and

NFC) as well as abilities to infer and reason". Service integrators have recently entered also the **mobility sector**. Companies such as Moovel Group GmbH (a joint venture of BMW Group and Daimler AG – see Albrecht and Ehmke (2016) and Willing et al. (2017a) for an overview) provide apps that strive to offer customers individual, context-aware and dynamic bundles of mobility services (Schulz et al. 2018). Real-time information about unforeseen events like train or bus cancellations or delays are collected and mobility service bundles are automatically adapted. Such mobility service bundles are highly customer-orientated, providing seamless mobility from origin to destination. This makes alternative mobility services (e.g., public transport, car-sharing) more attractive and contributes to reduced private car use, improving the quality of life, particularly in cities, by reducing traffic congestion and air and noise pollution (Willing et al. 2017a).

According to Willing et al. (2017a), the service integrators in the **travel sector**, which focus on the satisfaction of complex customer needs primarily in the case of leisure travel, can be considered predecessors of the service integrators in the **mobility sector**, whose focus is on urban mobility (e.g., commuting between work and home). Currently, however, the service bundles in both sectors cannot be considered fully 'smart'. For example, if a customer's flight is postponed until the next day, the hotel booking at the destination will not automatically be adapted. Similarly, Schulz et al. (2018) show that in the case of German public transport organizations the information technology (IT) required to generate real-time timetable data and mobile ticketing systems are not prevalent enough to enable smart bundling of mobility services. On the other hand, there are major differences in terms of the rate of cooperation between service integrators and service providers in both sectors. Most airlines and hotels – despite some attempts to disintermediate (McCubbrey and Taylor 2005) – participate in the service ecosystems of service integrators, which is less true among mobility providers. For instance, Albrecht and Ehmke (2016) show that only 44 percent of the service integrators operating in German-speaking areas can offer the mobility service provided by at least one public transport organization to their customers. Schulz and Überle (2018) point out that the embeddedness into existing service ecosystems and their institutional arrangements limits the need for public transport organizations to gain legitimacy by participating in the service ecosystems of service integrators.

The service-dominant (S-D) logic perspective is a suitable theoretical lens for analyzing service ecosystems and the resource integration and service exchange (i.e., value co-creation) of their actors. Originally introduced to marketing (Vargo and Lusch 2004), the S-D logic perspective is now well-established in various disciplines, including information systems (IS) (Giesbrecht et al. 2017; Lusch and Nambisan 2015, etc.). Several studies focusing on the provision of travel and mobility services (e.g., Fyrberg and Jüriado 2009; Hein et al. 2018; Schmidt-Rauch and Schwabe 2014; Schulz and Überle 2018) have also adopted the S-D logic perspective. However, S-D logic research on institutional arrangements that govern value co-creation is still in its infancy (Vargo and Lusch 2017). As a result, our knowledge of how the institutional arrangements of existing service ecosystems in which the service providers are embedded affect their disposition to establish a value co-creation relationship with service integrators is limited.

In this paper, we additionally draw on the concept of (countervailing) power to investigate the effects of different institutional arrangements on value co-creation. In the IS literature, the concept of power is often neglected (Jasperson et al. 2002; Simeonova et al. 2018). However, it is well-established in a number of research fields, such as administrative science (e.g., Pfeffer and Moore 1980) and marketing science (El-Ansary and Stern 1972; Etgar 1976; Frazier 1983, etc.). Maloni and Benton (2000, p. 53) define power as "the ability of one firm (the source) to influence the intentions and actions of another firm (the target)". Service integrators take an intermediary role between service providers, such as public transport organizations, and customers (Schulz et al. 2018), which might be associated with loss of power for service providers. A loss of power can be limited if service providers, such as hotel organizations, are able to market accommodations directly to customers by phone or via their own website, in addition to through the service platform of a service integrator. In other words, we assume that, based on the institutional arrangements of their service ecosystem, the service providers have various means of discouraging the service integrators from influencing their intentions and actions (i.e., exercising power). Such actions enable service providers to build 'countervailing power' (Galbraith 1993). In turn, the fear of loss of power might motive service providers, such as public transport organizations, to refuse to engage in value co-creation with service integrators. In this study, we pose the following research question: *How do existing institutional arrangements impede the ability of public transport organizations (in contrast to hotel organizations) to develop and maintain countervailing power?*

To answer this research question, we conducted qualitative interviews with representatives from 26 German public transport and hotel organizations. In our analysis, we focus on the institutional arrangements which govern the price and place policies of these organizations. Both policies are part of the marketing mix that reflects actions conducted by the organizations to offer their service successfully on the market (McCarthy 1960). We contribute to research by adding the concept of (countervailing) power to the S-D logic perspective that improves our understanding of the effects of institutional arrangements on value co-creation by actors. In addition, we create an awareness among practitioners of the potential negative effects of established institutional arrangements on the value co-creation of service providers, so that they can adjust the institutional arrangements to facilitate value co-creation, for example, among public transport organizations, which will make the mobility service bundles more attractive for customers.

The remainder of the paper is structured as follows: In the following section, we introduce the S-D logic perspective and the concept of (countervailing) power. After presenting our research methodology, we present the results of our qualitative interviews. Subsequently, we provide a discussion of the results, which also includes the limitations of our study and suggestions for future research. The paper ends with a conclusion.

Theoretical Background

Service-Dominant Logic Perspective

In modern economies, a shift can be observed from goods towards services. This shift has driven a change in the theoretical lens from the goods-dominant (G-D) logic to a new service-dominant (S-D) logic perspective. This is confirmed by authors from multiple research fields, including IS (Giesbrecht et al. 2017; Lusch and Nambisan 2015; Schmidt-Rauch and Schwabe 2014, etc.), who have adopted the S-D logic perspective. A service field where the S-D logic perspective is especially pronounced is travel (e.g., Brust et al. 2017; Schmidt-Rauch and Schwabe 2014). Fyrberg and Jüriado (2009) argue that due to the strong fragmentation and the thus necessary cooperation of a high number of actors in service ecosystems, this field offers a suitable environment for taking the S-D logic perspective. In contrast, the literature review of Brust et al. (2017) with a focus on IS literature show that the S-D logic perspective was not adopted in studies focusing on mobility services. More recently, however, several studies have adopted the S-D logic perspective (e.g., Hein et al. 2018; Schulz and Überle 2018; Turetken et al. 2019).

The key characteristics of G-D logic are a company- and output-centric perspective. Companies produce goods, such as cars, which they subsequently sell to customers. The customers have the role of passive recipients of the goods. The market transaction – a car in exchange for money – represents the principle of 'value-in-exchange' (Vargo and Lusch 2004). However, in practice, it can be observed "that customers increasingly move away from a goods-dominant perspective (e.g. buying a car) but rather look at the value (e.g., the flexibility and ease-of-use) offered by car sharing applications [or the websites or apps of service integrators] that provide a similar mode of transportation" (Gilsing et al. 2018, p. 2). In the case of these service platforms, providers and customers engage in resource integration and service exchange (i.e., value co-creation) throughout the service process, blurring the differences between their roles (Vargo and Lusch 2017). For example, a public transport organization can provide real-time updates (e.g., remaining trip duration) to its customers during the trip based on the GPS data from their smartphone. Hence, the principle 'value-in-exchange' that is valid in G-D logic is replaced by the principle of 'value-in-use' (Vargo and Lusch 2004) or, more recently, of 'value-in-context' (Vargo and Lusch 2017).

The S-D logic perspective is based on three elements: (1) the service ecosystem, (2) the service platform, and (3) value co-creation (Hein et al. 2018; Lusch and Nambisan 2015), which are explained below. The service-for-service exchange connects actors in a **service ecosystem**. This can be formally defined "as a relatively self-contained, self-adjusting system of mostly loosely coupled social and economic (resource-integrating) actors connected by shared institutional logics [a synonym for institutional arrangements] and mutual value creation through service exchange" (Lusch and Nambisan 2015, p. 161). According to this definition, for example, a single company and the global market each represent service ecosystems, albeit of different sizes (Koskela-Huotari et al. 2016). Schulz and Überle (2018) describe an exemplary service ecosystem for service integrators in the mobility sector, which includes different mobility providers (e.g., public transport organizations, car-sharing companies), government agencies, and customers. Service ecosystems are often interdependent because actors are simultaneously embedded in a number of service ecosystems (Akaka et al. 2013).

The coordination of actors and of their service-for-service exchange in and between service ecosystems is grounded on institutions (rules, norms, and beliefs) and institutional arrangements that represent collections of interrelated institutions (Akaka et al. 2013; Koskela-Huotari et al. 2016; Vargo and Lusch 2017). However, our current knowledge about institutional arrangements is very limited. Based on this fact, Vargo and Lusch (2017, p. 46) stated that "further study of institutions and institutional arrangements […] is needed". There is consensus, however, that institutional arrangements can not only enable service-for-service exchange, but, in the case of incompatibility, can also constrain it (Akaka et al. 2013; Koskela-Huotari et al. 2016). Schulz and Überle (2018) show how the embeddedness in the institutional arrangements of existing service ecosystems negatively influences the need for legitimation of mobility providers and thus ultimately leads to non-participation in the service ecosystems of service integrators.

The actors of a service ecosystem use a **service platform**, such as a website or an app, for their service-for-service exchange, which is "a modular structure that consists of tangible and intangible components (resources) and facilitates the interaction of actors and resources (or resource bundles)" (Lusch and Nambisan 2015, p. 162). The use of a service platform allows actors to conduct service-for-service exchange more efficiently (Hein et al. 2018; Lusch and Nambisan 2015).

Value co-creation takes place in the service ecosystem through resource integration and service exchange among actors (Vargo and Lusch 2017). Because value co-creation is difficult to observe empirically, actor engagement can serve as a microfoundation for value co-creation. In line with the definition of Storbacka et al. (2016, p. 3008), actor engagement is "both the actor's disposition to engage, and the activity of engaging in an interactive process of resource integration within a service ecosystem". By adding the concept of (countervailing) power to the S-D logic perspective, this study contributes to a better understanding of the effects of different institutional arrangements on value co-creation by actors. Thus, we make a contribution to develop S-D logic perspective towards "a general theory of value co[-]creation", as requested by Vargo and Lusch (2017, p. 46).

Adding the Concept of (Countervailing) Power to Service-Dominant Logic Perspective

The concept of power is suitable to our study for two main reasons. First, the results of Schulz et al. (2018) indicate that German public transport organizations do not want to become dependent on service integrators, and as a result have a low level of disposition to engage in value co-creation. Second, for decades, scholars in research fields spanning administrative science (e.g., Pfeffer and Moore 1980), marketing science (El-Ansary and Stern 1972; Etgar 1976; Frazier 1983, etc.), organizational theory (Clegg et al. 2006), political science (e.g., March 1966), and sociology (e.g., Emerson 1962) have illustrated the explanatory power of the concept of power. However, our literature review shows that power issues are often neglected in IS research (Jasperson et al. 2002; Simeonova et al. 2018), even though Markus (1983) highlighted the importance of the concept of power for the IS field over 35 years ago.

The term 'power' is not used uniformly or consistently by researchers from different fields. Jasperson et al. (2002, p. 399) observe that "researchers have used a single term, power, even though the term represents different ideas to the different researchers". The concept of power has many facets, such as authority, influence, and centralization (Jasperson et al. 2002). In this work, we draw on the definition of power by Maloni and Benton (2000, p. 53) as "the ability of one firm (the source) to influence the intentions and actions of another firm (the target)". Past studies have applied the concept of power to varying analytical scopes ranging from an individual, group, organizational, inter-organizational up to the nation-state level (e.g., Jasperson et al. 2002; Ogbonna and Wilkinson 1996). In the following, we review inter-organizational studies that focus on power issues in networks (organizational theory) and non-digital distribution channels (marketing science), which are very similar to those in service ecosystems. Subsequently, we provide an overview of IS studies in order to provide insights into the relationship between power and IT, such as the service platforms of service integrators.

Organizational theory deals with issues of power in an inter-organizational context, in which the relevant unit of analysis is the network. According to Grimshaw et al. (2005), there need not be a balance of power between the different actors involved in a network. Large companies may have a power advantage over smaller ones, public over private organizations (Harrison 1994; Smith 2000), and lead network companies over the other members of the networks. Applied to the S-D logic perspective, this means that service integrators may have power over other service ecosystem actors, and that public transport organizations may have less relative power than hotel organizations. The effects of power imbalance are manifold: For example, powerful companies can squeeze profits from other network companies by deflating prices (Grimshaw et al. 2005). In addition, they can also shift risk to the comparatively powerless (Harrison 1994; Semlinger 1992).

Marketing science adopts an inter-organizational perspective by analyzing power issues between the different companies in a distribution channel. The study of Ogbonna and Wilkinson (1996), for example, focuses on the grocery industry of the United Kingdom and how new distribution channels – beside own-label products, industry concentration, etc. – have changed the power relation between manufacturers and retailers. The literature provides two main explanations of the power differences between companies in distribution channels (Frazier et al. 1989). A number of authors (El-Ansary and Stern 1972; Etgar 1976, etc.) argue, for instance, that the greater a company's percentage contribution to another company's sales and profit, the greater the dependence. Other authors (e.g., Frazier 1983) explain that a company is powerful if it performs its role in the distribution channel well (so-called role performance), which reduces the attractiveness of alternative companies and/or attaches high costs to switching to alternative companies. Transferred to the S-D logic perspective, this means that the power of service integrators depends not least on potential alternative actors in the service ecosystems of service providers, which can assist in marketing their service. Through the lens 'countervailing power', which was coined by Galbraith (1993), the question is to what extent a company is able to prevent the exercise of power. Sources for countervailing power are, for example, high customer loyalty or high sales volume (Etgar 1976).

Jasperson et al. (2002) literature review offers an overview of **IS studies** dealing with the relationship between the concept of power including its different facets and IT. Some of the studies (e.g., Dennis et al. 1998; Hitt and Brynjolfsson 1997) show that IT is a driver for change in power structures (e.g., membership in a majority or minority). Other studies (Burkhardt and Brass 1990; Markus 1983, etc.) reveal that power concerns are an important factor for the resistance to and adoption of IT. More recently, Simeonova et al. (2018) presented an alternative classification of different forms of power in organizations, their perceived effects and the link to IS. In the present context, two of the described forms of power 'resource dependence' – dependency between branches, subsidiaries, supply chain partners, and alliance members (e.g., Cho et al. 2017) – and 'procedural' – procedures, rules, and norms of behavior (e.g., Blackler 2011) – are particularly important. In both cases, power acts as a restrictive force. Adapted to the S-D logic perspective, a resource dependency of hotel organizations would exist, for example, if the service platforms of service integrators are the only way to market accommodations in foreign markets.

Based on this multidisciplinary literature review, we conclude that introducing the concept of (countervailing) power to the S-D logic perspective can improve our understanding of how different institutional arrangements affect value co-creation of actors. In the following, we describe a qualitative study that we have carried out to analyze the institutional arrangements of the service ecosystems in which German hotel and public transport organizations are currently embedded. These institutional arrangements are the potential source of countervailing power of these organizations against service integrators. A lack of countervailing power will lead to a lack of disposition of these organizations to engage in value co-creation.

Methodology

Research Context

Our decision to conduct our study in Germany reflects the fact that service integrators have initially entered the European and in particular the German mobility sector (Willing et al. 2017b). Some reasons for this are the extensive pre-existing infrastructure, high public pressure, and existing legal conditions (Marx et al. 2015). In addition, the structure of the German travel and mobility sectors is comparable. Public transport is mainly organized by local transport and tariff associations, including public transport companies, such as bus and tram companies, as well as government agencies (e.g., state governments and city administrations). The transport and tariff associations are responsible for tariff setting and, in some cases, also for ticket distribution (Reinhardt 2012). Hotels belonging to a chain are in a similar situation in that they are not fully independent in their (price) decision making (Pellinen 2003). Another reason for choosing public transport companies and hotels as representatives from the mobility and travel sector, respectively, is their great importance for the German government and economy. In 2017, more than 10 billion trips were made by public transport. However, German public transport companies generated a loss of 3 billion euros (in 2016) paid for by public funds (Verband Deutscher Verkehrsunternehmen 2018). In contrast, German hotels generated net sales of 27 billion euros with about 289 million overnight stays (Hotelverband Deutschland (IHA) e.V. 2018).

Data Collection and Analysis

Due to the explorative character of our study in terms of the mobility sector (Albrecht and Ehmke 2016; Willing et al. 2017a; 2017b), we have decided to carry out a qualitative study. We conducted semi-structured interviews with representatives of German public transport and hotel organizations. Semi-structured interviews are appropriate because their open-ended nature makes them highly flexible and provide ample opportunity to discuss topics that arise during the interviews (Flick 2009). We sampled transport and tariff associations (TTAs) and public transport companies (TCs) (Reinhardt 2012; Wikipedia 2018) and drew on a list of members of the Hotelverband Deutschland (IHA) e.V. (2017), which represents single hotels (SHs), single hotels belonging to hotel chains (SHCs), and hotel chains (HCs). Initially, organizations were chosen at random, then the sample was supplemented by selecting organizations missing (e.g., in terms of turnover or location). We first contacted the managing director responsible for entering the service ecosystem of a service integrator and for the management of the underlying value co-creation relationship. Then we used a snowball sampling approach to identify further or more appropriate experts, such as head of marketing and distribution. This approach helps mitigate potential bias.

We contacted 307 organizations, 26 of which agreed to an interview. The interviews were conducted between April and July 2018. In one case, there was a joint interview with two representatives of a public transport company (TC4.1 and TC4.2). We followed semi-structured interview guidelines with four question blocks: personal data, characteristics of the organization, business topics (e.g., choice of distribution channels, pricing), and technical topics (e.g., data exchange). The interviews lasted between 18 and 61 minutes, with an average duration of 40 minutes. With the exception of the interview with TC1 (no agreement; handwritten notes) the interviews were recorded and transcribed. Following a data triangulation strategy (Flick 2009; Miles et al. 2014), secondary data, such as websites and press releases, was used to validate and flesh out interviewee statements. We excluded the organizations TC1 and TTA1 from further analysis after representatives told us that they were not aware of a value co-creation relationship with a service integrator, in contradiction of a claim on the website of a service integrator.

We analyzed the data using NVivo 12 software. First the member of the research team independently coded the data, to reduce potential coding bias. We used the higher-level coding categories price, place, product, and promotion policy that reflect the marketing mix (McCarthy 1960) to classify the respective institutional arrangements. Building on this, we gain insights into the (possible) actions of the organizations and their ability to build up countervailing power against service integrators. In this paper, the focus is on the institutional arrangements, which are related to price and place policy. The subcategories were derived from the data. The coding results were discussed by the research team and coding discrepancies were negotiated until a common understanding was reached. We stopped collecting data when data analysis no longer provided additional insights (Yin 2014).

Results

Price Policy

We adopt the S-D logic perspective, extended by the concept of (countervailing) power, to identify the institutional arrangements (related to price and place policy) of the service ecosystems of public transport organizations which negatively affect their ability to build up countervailing power against service integrators and possibly limit their disposition to engage in value co-creation. In order to gain insights into possible adjustments of the institutional arrangements, we compared their situation with that of hotel organizations. The following statement by TC6 initially highlights that the concept of power is important to better understand the lack of value co-creation by public transport organizations:

> *"Where might it make sense to cooperate? And I already mentioned the topic of dependency. Of course, we always take a close look at this topic. To what extent do we make ourselves or our business activity dependent on a third party (a platform), where we perhaps no longer have our business activities as firmly under our control as we actually want to?"*.

A first reason for the comparatively low countervailing power of public transport organizations are **non-dynamic prices** for tickets, which could cement a price disadvantage over competitors (e.g., taxi and car-sharing companies). This is due to the existing contracts (TC4.2; TC12; TTA2; TTA3; etc.), which govern the value co-creation of public transport companies and government agencies within transport and tariff associations. For example, TC2 stated that

> *"we in our sector assume that it has to be enough to set tariffs once a year, because the district government (here in North-Rhine Westphalia it is the district government) requires the tariffs to be approved. However, due to digitalisation we need greater flexibility"*.

Similarly, TC9 expected that there will be dynamic pricing in the future. TC3 explained that it is important that the government agencies approve the ticket prices since the public transport companies generate a large deficit paid for by the city ("*classic public transport will never make a profit. It is not there for that purpose. It is for the citizens. It is a basic service"*).

In line with this public service logic, ticket prices offered by public transport organizations are often **personalized prices** that ensure affordable mobility to all population groups (people with low incomes, elderly, etc.). For example, TC10 (comparable TTA3) stated that

> *"subscriptions have great price advantages compared to a single ticket. Of course, we try to do something with individually tailored tickets. (...). There are special tickets for school children. There are special tickets for seniors"*.

As in the case of non-dynamic prices, this public service logic leads to a disadvantage compared with service integrators and private mobility providers who leverage higher profit target groups. The frequent stipulation in the existing contracts (e.g., TC10; TC11) that **uniform prices** be applied to all distribution channels (e.g., buying a ticket from the driver, ticket machines) also limits the ability of public transport organizations to build up countervailing power against service integrators that operate service platforms (a website or an app). The following statement by TC2 illustrates his dissatisfaction with this practice:

> *"we are currently discussing this issue within the transport and tariff association. (...). At least my approach, not everyone shares this opinion, would be to make the digital distribution channel cheaper. Let me give you an example. A single ticket, if I buy it digitally, cost 2,50 Euro. If I buy the ticket from the driver, it costs 3 Euro"*.

TC5 and TC6 reported, however, that ticket prices are already being set in this way. Another form of price differentiation which is used are **bundled prices** (TC3; TC4.2; TC5). For example, subscribers may get a discount at local museums or theaters. In one case, subscribers pay a discounted price for a car-sharing service also offered by the public transport organization. Such bundled prices can increase the attractiveness of their own distribution channels compared to the service platforms of service integrators. In other words, they contribute to their countervailing power.

In summary, it can be stated that the public transport organizations have a relatively rigid price policy due to the institutional arrangements of their existing service ecosystems. One reason is the expectation of government agencies to provide affordable mobility to all population groups. In conjunction with the assumption that service integrators can better fulfill the complex mobility needs of customers, this results in a low countervailing power. Our data analysis indicates that hotel organizations have greater opportunities to build up countervailing power against service integrators. One means are **dynamic prices** (e.g., SHC2; HC2; HC6; HC8). For example, according to SH1, room prices are set depending on

> "*the events that are taking place in Berlin, on the historical data, (...), and a set of competitors (i.e., comparable hotels here in this area) with which we compare ourselves*". In addition, "*they [dynamically] change according to supply and demand*" (HC3).

Hotel organizations that feel the competitive pressure of other hotel organizations or service integrators can thus change room prices several times a day to respond to competitors and manage customer demand. Closely related to this approach is the use of **non-uniform prices** for different distribution channels (SH1; HC1; etc.). Several interviewees (SHC1; HC6) pointed out that until recently there was a price parity clause. As SHC2 explained exemplarily:

> "*Since last year, this price parity clause is no longer permissible. The booking platforms have always insisted that the cheapest price must be offered by them. So it always had to be the same price on all distribution channels. In other words, we were not allowed to sell our rooms cheaper than Booking.com*".

Now the hotel organizations can set lower room prices, thus limiting the power of service integrators and their service platforms, which is otherwise associated with the provision of price transparency. In contrast, only HC5 stated that uniform prices will continue to be charged for all distribution channels.

A special case are the **personalized prices** set for business travelers – at the company level (SHC2; HC7) – and tour operators (HC1; HC4; HC7), which are relatively rigid and differ from those of the other distribution channels. HC6 provided an explanation for this procedure:

> "*A tour operator needs fixed prices because without fixed prices no price table can be created. According to the current case law, the tour operator is, however, obliged to do this*".

Table 1 summarizes the different price policies of the hotel and public transport organizations that depend on the institutional arrangements of their service ecosystem. In this way, the institutional arrangements determine the extent to which the organizations can build up countervailing power against service integrators, and thus their disposition to engage in value co-creation. The price policy that contributes to countervailing power is marked in grey.

Table 1. Comparison of the Price Policies of Hotel and Public Transport Organizations.

Public transport companies and transport and tariff associations	**Hotels and hotel chains**
Non-dynamic prices	Dynamic prices
Personalized prices	Personalized prices
Uniform prices	Non-uniform prices
Bundled prices	Non-bundled prices

Place Policy

Similarly, in the case of place policy, the public transport organizations face institutional arrangements of their service ecosystems that negatively affect their ability to build up countervailing power against service integrators. Numerous interviewees highlighted that they are **not free to choose their**

distribution channels, such as the sale of tickets through the driver or ticket machines. For instance, TC10 stated that there is a great influence from government agencies:

> "*Our actions are strongly influenced by the political side. For example, political representatives from the cities are members of our supervisory board. (…). What about citizens who don't have a smartphone? There is always a lot of emphasis placed on the fact that there are also other ways to buy a ticket. (…). For example, we will still offer the paper-based ticket in parallel for some time"*.

This quotation demonstrates that the choice of distribution channels is often influenced by the public service logic to provide the most appropriate distribution channel for each population group, for instance elderly people (TC5; TC8; TC11). In addition, TC8 (comparable TC11; TC12) pointed out that government agencies use gross-cost tenders, wherein the revenue risk is born by the contracting authority, to make specifications regarding the choice of distribution channels:

> *"We know how to design and operate an app. The question is, do our customers want an app? And with customers – you have to keep that in mind – we usually mean the state as contracting authority (…) who determine the price we receive and the service features. If we have a customer who wants a fancy app, then we will provide one. (…). Our customers in North-Rhine Westphalia don't want an app"*.

In contrast, economic considerations are often of minor importance – "*we as public transport are not always required to consider sales issues but we should rather provide citizen services"* (TC3). The low focus on digital distribution channels is also caused by the fact that these are hardly used by customers – "*the digital market is currently one percent"* (TC2; see also TC9; TC12). In summary, the strong political influence results in a mix of a large number of digital and non-digital distribution channels, which makes it difficult for public transport organizations to make their direct distribution efficient compared to the indirect distribution via the service platforms of service integrators (TC5; TC10). This is associated with a low countervailing power of public transport organizations.

In response to the political desire to offer affordable mobility, a high number of different tickets (tickets for school children or students, day and monthly pass, etc.) exists. This fragmentation makes it **difficult for public transport organizations to optimize their distribution in the short-term**, since usually not all tickets are offered through one distribution channel (TC3; TC4.1; TC9; TC10). One underlying reason for this are the different media used to distribute tickets:

> "*Drivers don't sell the full range of tickets, but for example single and four ticket [paper-based tickets]. (…). In the case of the subscriptions, we have electronic tickets, i.e. chip cards"* (TC2).

Another reason is the attempt to increase the attractiveness of digital distribution channels (TC2; TC10). As a result of the fragmentation, the public transport organizations have little countervailing power as price or quantity adjustments are difficult to conduct in the case of some distribution channels, making it nearly impossible to manage distribution through the service platforms of service integrators.

In contrast to this, the **protected local market** in which the public transport organizations operate – among others by the German Public Transport Act (TTA2; similarly TC5) – offers the opportunity to build up strong countervailing power. Some interviewees also emphasized high infrastructure cost, with the consequence that there "*are not two competing public transport companies providing the same route"* (TTA2; see also TTA3). Such a protected market enables public transport organizations to prohibit service integrators from selling tickets for the area and ensures that they have some benefit of bearing the full business risks (e.g., investments in the rail network) (TC9; TTA3).

In comparison, the institutional arrangements that the hotel organizations face offer greater possibilities to build up countervailing power. First, the interviewees (HC1; HC6; HC8; etc.) stressed that they are **free to choose their distribution channels** on the basis of business considerations:

> "*This means that we are open to all distribution channels. However, we evaluate them according to a portfolio of criteria: What do they cost us? What do they bring us? What coverage do we achieve? What information about customers can we generate? How many new potential customers do we reach?"* (HC3).

Another important consideration in this context is how to limit the power of service integrators and their service platforms. This distribution channel is relatively expensive (e.g., SHC2; HC6; HC8) and there is also the risk of losing customer contact (HC3; HC5). Nevertheless, service integrators are already so well established in the market that it is not possible to completely eliminate this distribution channel:

> "*If the hotel sector could, it would shoot all the booking platforms to the moon. Unfortunately, that is no longer possible"* (SHC2).

In contrast to public transport organizations, hotel organizations **can optimize their distribution in the short-term** by conducting price or quantity adjustments for individual distribution channels, which contributes to their countervailing power:

> "*These flash sales serve mainly to create a basic utilisation. The offers are always discounted, so the rate is relatively low, but we get a lot of volume. The risk is small because these flash sales last a week or maximum 14 days"* (SH1; see also HC1) and

> "*then, of course, it is the case that the hotels close indirect distribution first and leave direct distribution open for the longest time, in order to increase net revenue per room, i.e. to reduce commission costs"* (HC3; similarly HC2; HC6).

On the other hand, the hotel organizations operate in a **global market** and dependent on the service platforms of service integrators (SHC1; SHC2; HC1; HC3; etc.). HC8, for instance, highlighted that these can help to save costs:

> "*If you have a lot of international business (...) Asians, Russians, Israelis, i.e., all countries where you have language issues, (...) you must calculate for each case: What would it cost for me to open up this market? Or, should I have a specialist do it?"*.

The balance between power of service integrators and countervailing power of hotel organizations has changed over time – "*There are times when they say: 'We don't care!'; There are times when we say: 'That doesn't interest us!'"* (HC8). According to HC8, hotel chains have greater countervailing power, since service integrators "*just have to talk to only one responsible person per country who takes care of the hotels"*. Table 2 shows the place policies of hotel and public transport organizations which depend on the institutional arrangements of their service ecosystems. The place policy that serves as a source of countervailing power for organizations is marked in grey.

Table 2. Comparison of the Place Policies of Hotel and Public Transport Organizations.

Public transport companies and transport and tariff associations	**Hotels and hotel chains**
Not free choice of distribution channels	Free choice of distribution channels
Long-term price and quantity optimization	Short-term price and quantity optimization
Local market	Global market

In summary, our study shows that public transport organizations – in contrast to hotel organizations – are embedded in service ecosystems which are characterized by institutional arrangements concerning price and place policy that negatively affect their ability to build up countervailing power. This in turn might be one reason for their observed low disposition to engage in value co-creation with service integrators (Schulz et al. 2018; Schulz and Überle 2018; Willing et al. 2017a; 2017b).

Discussion

Our theoretical approach and the results of our qualitative study are new in several respects, which allows us to make important contributions. First, the focus on service ecosystems in the travel and mobility sector helps us to *further establish the S-D logic perspective* in science and practice. Although a large number of authors (e.g., Brust et al. 2017; Fyrberg and Jüriado 2009; Schmidt-Rauch and Schwabe 2014) whose focus is on different fields of service, including travel services, have adopted the S-D logic perspective, there are only a few studies centered on mobility services (e.g., Hein et al. 2018;

Schulz and Überle 2018; Turetken et al. 2019). With our analysis of service ecosystems of German public transport organizations, we contribute to the closure of this gap. In addition, S-D logic research to date has often been limited to service ecosystems which are located in a single sector, such as the mobility sector (Hein et al. 2018; Schulz and Überle 2018; Turetken et al. 2019). As a consequence, the derived results can be transferred only to a limited extent to other service fields. Our research approach to compare service ecosystems of two sectors contributes to a broader theoretical foundation of the S-D logic perspective. Based on this foundation, we are able to inform practitioners about cross-sector best practice solutions. In our case, we illustrate how the institutional arrangements regarding price and place policy established in the service ecosystems of public transport organizations negatively affect their ability to build up countervailing power, and thus their disposition to engage in value co-creation with a service integrator. By comparing their situation with hotel organizations, practitioners can gain valuable insights into how institutional arrangements should be redesigned (see Table 1 and 2).

Secondly, we *further developed the S-D logic perspective* (Vargo and Lusch 2004) towards a midrange theory. In doing so, we followed the call of Vargo and Lusch (2017) to use theories (the concept of countervailing power) outside of marketing. In the S-D logic literature, the knowledge about the institutional arrangements is scarce (Vargo and Lusch 2017). Akaka et al. (2013) and Koskela-Huotari et al. (2016) emphasize in general terms that institutional arrangements can enable or constrain value co-creation in and between service ecosystems. Schulz and Überle (2018) show in more detail how existing institutional arrangements constrain legitimacy needs of mobility providers, and thus their disposition to enter into a value co-creation relationship with service integrators. Similarly, we draw on the concept of power, or more precisely countervailing power (Galbraith 1993), which is established in various scientific disciplines (e.g., El-Ansary and Stern 1972; Emerson 1962; Jasperson et al. 2002; March 1966; Pfeffer and Moore 1980) to theorize about the effects of institutional arrangements on value co-creation. With the results of our qualitative study, we provide empirical evidence of how different institutional arrangements regarding price and place policy enable or constrain value co-creation by service providers by affecting their ability to build up countervailing power against service integrators. Hence, we contribute to a better understanding of (lacking) value co-creation between actors of different service ecosystems by introducing the concept of countervailing power in the S-D logic literature. Future research can build on this extended theoretical foundation.

Lastly, we contribute *to closing research gaps concerning service and smart integrators*. Currently, research on service integrators is still in its infancy (Alt et al. 2019), especially in the field of mobility (Schulz et al. 2018; Schulz and Überle 2018). In particular, the underlying reasons why only a few mobility providers cooperate with service integrators have received little research attention (Albrecht and Ehmke 2016; Willing et al. 2017a; 2017b). The previous work highlights that there are technical difficulties, as the mobility providers often do not have the necessary IT infrastructure in place (Schulz et al. 2018). In addition, they have only little need to gain legitimacy of stakeholders by cooperating with service integrators (Schulz and Überle 2018). We complement this research by analyzing an additional reason – the fear of possible economic dependence due to the loss of the ability to build up countervailing power on the basis of their price and place policy. By carrying out a cross-sector analysis, comparing the situation of German hotel and public transport organizations, our results show, for example, that the public service logic of government agencies that all population groups (e.g., elderly people without smartphone) should have access to mobility negatively affects the countervailing power of public transport organizations by restricting their place policy. For instance, they are forced to continue operating non-digital distribution channels, such as the driver selling paper-based tickets, which makes their distribution inflexible, as no short-term price or quantity adjustments for several distribution channels are possible. This leads to a low countervailing power against service integrators, which might cause non-cooperation. As a result, entrepreneurial opportunities offered by service integrators, such as profit maximization through dynamic pricing or business area optimization on the basis of big data analyses (Willing et al. 2017a), can also not be exploited. In addition, the complex mobility needs of customers are not satisfied (Alt et al. 2019), which contributes to the attractiveness of private car use, and thus to problems such as traffic congestion, as well as air and noise pollution (Willing et al. 2017a). In this vein, our study can be seen as a call to policy to review their wishes and expectations, as they greatly restrict the price and place policy of public transport organizations and hence their ability to build up countervailing power against service integrators.

This work points to areas of potentially fruitful future research. Our study is limited to Germany because in the case of mobility, service integrators have predominantly entered the European, in particular German, market (Marx et al. 2015; Willing et al. 2017b). Our results show, however, that the institutional arrangements promoted by government agencies often negatively affect the ability of public transport organizations to build up countervailing power, and based on this, their disposition to engage in value co-creation with service integrators. Studies that focus on service ecosystems, which are located in different countries and thus are embedded in varying institutional arrangements would contribute to the generalizability of our results. In addition, the analysis of the institutional arrangements related to the product and promotion policy – the both remaining instruments of the marketing mix (McCarthy 1960) – would extend our study. Future research can also investigate how the balance between power and countervailing power of different service ecosystem actors changes over time, possibly from an activity theory perspective (Simeonova et al. 2018).

Conclusion

Service integrators are in a better position than single service providers to satisfy complex customer needs. The aim of this work was to gain knowledge why a high number of public transport organizations, in contrast to hotel organizations, do not cooperate with service integrators. For this purpose, we adopted the S-D logic perspective, which we expanded by including the concept of (countervailing) power. The results of a qualitative study with German hotel and public transport organizations reveal that, in particular, the institutional arrangements promoted by government agencies restrict the price and place policies of public transport organizations. This, in turn, negatively affects their ability to build up countervailing power, and thus, their disposition to engage in value co-creation.

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References

Akaka, M. A., Vargo, S. L., and Lusch, R. F. 2013. "The Complexity of Context: A Service Ecosystems Approach for International Marketing," *Journal of International Marketing* (21:4), pp. 1-20.

Albrecht, L., and Ehmke, J. F. 2016. "Innovative Services in der Mobilitätsbranche: Eine Marktanalyse multimodaler Mobilitätsmanager," *Multikonferenz Wirtschaftsinformatik*, Ilmenau.

Alt, R., Ehmke, J. F., Haux, R., Henke, T., Mattfeld, D. C., Oberweis, A., Paech, B., and Winter, A. 2019. "Towards Customer-Induced Service Orchestration - Requirements for the Next Step of Customer Orientation," *Electronic Markets* (29:1), pp. 79-91.

Andrés, L., Cuberes, D., Diouf, M., and Serebrisky, T. 2010. "The Diffusion of the Internet: A Cross-Country Analysis," *Telecommunications Policy* (34:5-6), pp. 323-340.

Blackler, F. 2011. "Power, Politics, and Intervention Theory: Lessons from Organization Studies," *Theory & Psychology* (21:5), pp. 724-734.

Brust, L., Breidbach, C. F., Antons, D., and Salge, T. O. 2017. "Service-Dominant Logic and Information Systems Research: A Review and Analysis Using Topic Modeling," *International Conference on Information Systems*, Seoul.

Burkhardt, M. E., and Brass, D. J. 1990. "Changing Patterns or Patterns of Change: The Effects of a Change in Technology on Social Network Structure and Power," *Administrative Science Quarterly* (35:1), pp. 104-127.

Cho, B., Ryoo, S. Y., and Kim, K. K. 2017. "Interorganizational Dependence, Information Transparency in Interorganizational Information Systems, and Supply Chain Performance," *European Journal of Information Systems* (26:2), pp. 185-205.

Clegg, S. R., Courpasson, D., and Phillips, N. 2006. *Power and Organizations*. London: SAGE Publications.

Dennis, A. R., Hilmer, K. M., and Taylor, N. J. 1998. "Information Exchange and Use in Gss and Verbal Group Decision Making: Effects of Minority Influence," *Journal of Management Information Systems* (14:3), pp. 61-88.

El-Ansary, A. I., and Stern, L. W. 1972. "Power Measurement in the Distribution Channel," *Journal of Marketing Research* (9:1), pp. 47-52.

Emerson, R. M. 1962. "Power-Dependence Relations," *American Sociological Review* (27:1), pp. 31-41.

Etgar, M. 1976. "Channel Domination and Countervailing Power in Distributive Channels," *Journal of Marketing Research* (13:3), pp. 254-262.

Flick, U. 2009. *An Introduction to Qualitative Research*. London: SAGE Publications.

Frazier, G. L. 1983. "On the Measurement of Interfirm Power in Channels of Distribution," *Journal of Marketing Research* (20:2), pp. 158-166.

Frazier, G. L., Gill, J. D., and Kale, S. H. 1989. "Dealer Dependence Levels and Reciprocal Actions in a Channel of Distribution in a Developing Country," *Journal of Marketing* (53:1), pp. 50-69.

Fyrberg, A., and Jüriado, R. 2009. "What About Interaction? Networks and Brands as Integrators within Service-Dominant Logic," *Journal of Service Management* (20:4), pp. 420-432.

Galbraith, J. K. 1993. *American Capitalism: The Concept of Countervailing Power*. New York: Routledge.

Giesbrecht, T., Schwabe, G., and Schenk, B. 2017. "Service Encounter Thinklets: How to Empower Service Agents to Put Value Co-Creation into Practice," *Information Systems Journal* (27:2), pp. 171-196.

Gilsing, R., Turetken, O., Adali, O. E., and Grefen, P. 2018. "A Reference Model for the Design of Service-Dominant Business Models in the Smart Mobility Domain," *International Conference on Information Systems*, San Francisco.

Gretzel, U., Sigala, M., Xiang, Z., and Koo, C. 2015. "Smart Tourism: Foundations and Developments," *Electronic Markets* (25:3), pp. 179-188.

Grimshaw, D., Willmott, H., and Rubery, J. 2005. "Inter-Organizational Networks: Trust, Power, and the Employment Relationship," in *Fragmenting Work: Blurring Organizational Boundaries and Disordering Hierarchies*, M. Marchington, D. Grimshaw, J. Rubery and H. Willmott (eds.). New York: Oxford University Press, pp. 39-62.

Harrison, B. 1994. *Lean and Mean: The Changing Landscape of Corporate Power in the Age of Flexibility*. New York: The Guilford Press.

Hein, A., Scheiber, M., Böhm, M., Weking, J., Rocznik, D., and Krcmar, H. 2018. "Toward a Design Framework for Service-Platform Ecosystems," *European Conference on Information Systems*, Portsmouth.

Hitt, L. M., and Brynjolfsson, E. 1997. "Information Technology and Internal Firm Organization: An Exploratory Analysis," *Journal of Management Information Systems* (14:2), pp. 81-101.

Hotelverband Deutschland (IHA) e.V. 2017. "Hotelführer". Retrieved 18-12-2017, from https://www.hotellerie.de/go/aktuelle_suche

Hotelverband Deutschland (IHA) e.V. 2018. "Hotelmarkt Deutschland weiter auf Wachstumskurs". Retrieved 15-05-2019, from https://www.iha-service.de/de/hotelmarkt-deutschland-weiter-auf-wachstumskurs

Jasperson, J. S., Carte, T. A., Saunders, C. S., Butler, B. S., Croes, H. J. P., and Zheng, W. 2002. "Review: Power and Information Technology Research: A Metatriangulation Review," *MIS Quarterly* (26:4), pp. 397-459.

Koskela-Huotari, K., Edvardsson, B., Jonas, J. M., Sörhammar, D., and Witell, L. 2016. "Innovation in Service Ecosystems—Breaking, Making, and Maintaining Institutionalized Rules of Resource Integration," *Journal of Business Research* (69:8), pp. 2964-2971.

Lusch, R. F., and Nambisan, S. 2015. "Service Innovation: A Service-Dominant Logic Perspective," *MIS Quarterly* (39:1), pp. 155-175.

Maloni, M., and Benton, W. C. 2000. "Power Influences in the Supply Chain," *Journal of Business Logistics* (21:1), pp. 49-73.

March, J. G. 1966. "The Power of Power," in *Varieties of Political Theory*, D. Easton (ed.). Englewood Cliffs: Prentice-Hall, pp. 39-70.

Markus, M. L. 1983. "Power, Politics, and MIS Implementation," *Communications of the ACM* (26:6), pp. 430-444.

Marx, R., de Mello, A. M., Zilbovicius, M., and de Lara, F. F. 2015. "Spatial Contexts and Firm Strategies: Applying the Multilevel Perspective to Sustainable Urban Mobility Transitions in Brazil," *Journal of Cleaner Production* (108), pp. 1092-1104.

McCarthy, E. J. 1960. *Basic Marketing: A Managerial Approach*. Homewood: Richard D. Irwin.

McCubbrey, D. J., and Taylor, R. G. 2005. "Disintermediation and Reintermediation in the U.S. Air Travel Distribution Industry: A Delphi Reprise," *Communications of the Association for Information Systems* (15).

Miles, M. B., Huberman, A. M., and Saldaña, J. 2014. *Qualitative Data Analysis: A Methods Sourcebook*. Los Angeles: SAGE Publications.

Ogbonna, E., and Wilkinson, B. 1996. "Inter-Organizational Power Relations in the UK Grocery Industry: Contradictions and Developments," *The International Review of Retail, Distribution and Consumer Research* (6:4), pp. 395-414.

Pellinen, J. 2003. "Making Price Decisions in Tourism Enterprises," *International Journal of Hospitality Management* (22:2), pp. 217-235.

Pfeffer, J., and Moore, W. L. 1980. "Power in University Budgeting: A Replication and Extension," *Administrative Science Quarterly* (25:4), pp. 637-653.

Reinhardt, W. 2012. *Öffentlicher Personennahverkehr: Technik - rechtliche und betriebswirtschaftliche Grundlagen*. Wiesbaden: Vieweg+Teubner Verlag.

Schmidt-Rauch, S., and Schwabe, G. 2014. "Designing for Mobile Value Co-Creation—the Case of Travel Counselling," *Electronic Markets* (24:1), pp. 5-17.

Schulz, T., Gewald, H., and Böhm, M. 2018. "The Long and Winding Road to Smart Integration of Door-to-Door Mobility Services: An Analysis of the Hindering Influence of Intra-Role Conflicts," *European Conference on Information Systems*, Portsmouth.

Schulz, T., and Überle, M. 2018. "How Institutional Arrangements Impede Realization of Smart Ecosystems: The Case of Door-to-Door Mobility Integrators," *European Conference on Information Systems*, Portsmouth.

Semlinger, K. 1992. "Small Firms in Big Subcontracting," in *Technology and Work in German Industry,* N. Altmann, C. Köhler and P. Meil (eds.). London: Routledge, pp. 342-360.

Simeonova, B., Karanasios, S., Galliers, R. D., Kelly, P. R., and Mishra, J. 2018. "Where Is Power in Information Systems Research? Towards a Framework," *International Conference on Information Systems*, San Francisco.

Smith, T. 2000. *Technology and Capital in the Age of Lean Production: A Marxian Critique of the "New Economy"*. Albany: State University of New York Press.

Storbacka, K., Brodie, R. J., Böhmann, T., Maglio, P. P., and Nenonen, S. 2016. "Actor Engagement as a Microfoundation for Value Co-Creation," *Journal of Business Research* (69:8), pp. 3008-3017.

Turetken, O., Grefen, P., Gilsing, R., and Adali, O. E. 2019. "Service-Dominant Business Model Design for Digital Innovation in Smart Mobility," *Business & Information Systems Engineering* (61:1), pp. 9-29.

Vargo, S. L., and Lusch, R. F. 2004. "Evolving to a New Dominant Logic for Marketing," *Journal of Marketing* (68:1), pp. 1-17.

Vargo, S. L., and Lusch, R. F. 2017. "Service-Dominant Logic 2025," *International Journal of Research in Marketing* (34:1), pp. 46-67.

Verband Deutscher Verkehrsunternehmen. 2018. "2017 Statistik".

Wikipedia. 2018. "Liste deutscher Tarif- und Verkehrsverbünde". Retrieved 2018-05-13, from https://de.wikipedia.org/wiki/Liste_deutscher_Tarif-_und_Verkehrsverb%C3%BCnde

Willing, C., Brandt, T., and Neumann, D. 2017a. "Electronic Mobility Market Platforms – a Review of the Current State and Applications of Business Analytics," *Electronic Markets* (27:3), pp. 267-282.

Willing, C., Brandt, T., and Neumann, D. 2017b. "Intermodal Mobility," *Business & Information Systems Engineering* (59:3), pp. 173-179.

Yin, R. K. 2014. *Case Study Research: Design and Methods*. Thousand Oaks: SAGE Publications.

Appendix G. Information Technology Choice in Mobility Service Ecosystems: A Qualitative Comparative Analysis (P6)

Information Technology Choice in Mobility Service Ecosystems: A Qualitative Comparative Analysis

Completed Research Paper

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Abstract

Cities around the globe face mobility-related challenges such as traffic congestion and air and noise pollution caused by the extensive use of private cars. Smart solutions promise to make urban mobility more intelligent, interconnected, and efficient using information technology (IT). This study analyzes IT choice in the service ecosystems of different German transport and tariff associations. Taking a service-dominant logic perspective, we apply fuzzy-set qualitative comparative analysis (fsQCA) in order to identify the configurations of attributes levels characterizing the actors and institutional arrangements of each service ecosystem that are linked to the choice of state-of-the-art IT. Our results reveal that the availability of a high number of car-sharing actors in the service ecosystem is a necessary condition for choosing state-of-the-art IT. Our study guides decision-makers in responding to mobility challenges caused by the predominant usage of the private car and thus contributes to the overarching goal of achieving livable cities.

Keywords: Information Technology Choice, Public Transport Service, Qualitative Comparative Analysis (QCA), Service-Dominant Logic, Smart Mobility

Introduction

All large cities around the world face mobility-related challenges. Extensive private car use causes air and noise pollution, which endangers the health and well-being of urban citizens. In addition, private car use also contributes to higher traffic congestion and parking problems associated with lost productivity (Benevolo et al. 2016; Caiati et al. 2020; Willing et al. 2017a; b). Expanding the existing road capacity is often practically impossible, prohibitively expensive or detrimental to the cities' quality of life. This situation is expected to worsen over time. According to the United Nations Department of Economic and Social Affairs (2015), 66% (up from 50% in 2015) of the worldwide population will live in cities by 2050, and private car use is expected to rise accordingly unless viable alternatives are available. As a result, cities worldwide need a new urban mobility paradigm to improve the living conditions of their citizens and to remain functional for generations to come.

Over the last few years, the increased digital connectivity of the population has contributed to the popularity of more sustainable mobility services, such as bike-sharing (Jäppinen et al. 2013; Shaheen et al. 2010), car-sharing (Hildebrandt et al. 2015), and ride-sharing (Teubner and Flath 2015) by making these mobility services more convenient to use (Puschmann and Alt 2016; Watson et al. 2011; Willing et al. 2017a; b). Especially the number of car-sharing users has risen as the concept of a sharing economy shifts the focus from ownership to access (Hendzlik et al. 2016; Shaheen et al. 2009). In particular among the younger generation, the private car has become less of a status symbol and car ownership is considered less important (Belk 2014). In line with this changing mindset, our society is currently at a tipping point driven by the necessity for change, the use of advanced information technology (IT), and the growing willingness of citizens to change their behavior towards a more sustainable mobility.

Long-established public transport companies need to respond to these developments and adapt their mobility services to remain competitive. The study by Beirão and Cabral (2007) shows, for example, that a poor information quality and the station-based nature of the service are factors of non-usage of public transport. In this vein, Watson et al. (2011, p. 59) highlight that the provision of the “right information at the right time” can facilitate a change towards a more sustainable behavior, such as a shift from the use of the private car to the use of public transport. A study of the attributes of smartphone apps (hereinafter referred to simply as apps) provided by German transport and tariff associations that represent the public transport companies in a local geographic area, shows that customers get access to a variety of information about, among others, the location of a station, the position of busses or trains in real-time, and ticket prices and purchase options (Zimmermann et al. 2020). In summary, the provision of apps by transport and tariff associations thus contributes to making public transport more attractive for (potential) customers and to strengthening its competitiveness vis-à-vis private mobility services, such as those of car-sharing companies (Willing et al. 2016).

However, the desire of the society for a more sustainable mobility behavior requires public transport companies to focus not solely on their own mobility service. The reason for this is that the mobility needs of citizens are often complex. For example, in order to get from home to work, some citizens will need to combine different mobility services such as bus, train, and bike-sharing. Research into bundling multiple mobility services during a trip from an origin to a destination refers to ‘intermodal mobility’ (Schulz et al. 2020a; Willing et al. 2017b), ‘mobility as a service’ (MaaS) (Giesecke et al. 2016) and ‘smart mobility’ (Schulz et al. 2020b). Apps provided either by public transport companies and transport and tariff associations, respectively, or by a third party can facilitate the bundling of mobility services (Schulz et al. 2020a; b). For instance, based on real-time timetable data provided by sensors in vehicles, the combination of mobility services is dynamically adjusted in the event of a delay or cancellation. As a result, these apps contribute to greater satisfaction of the mobility needs of citizens in terms of identifying, comparing, and coordinating multiple mobility services at low cost.

Several studies (e.g., Caiati et al. 2020; Willing et al. 2017a) show that public transport is not in competition with other mobility services and thus public transport companies can expect economic benefits from bundling. In order to provide a bundled mobility service to customers, multiple mobility providers form a service ecosystem and exchange large amounts of data (e.g., ticket prices, real-time timetable information) (Lusch and Nambisan 2015; Schulz et al. 2020b). However, existing studies (e.g., Albrecht and Ehmke 2016; Schulz et al. 2020b; Willing et al. 2017a; b) show that, for instance, German public transport companies are rarely able to provide the required data to the other mobility providers of the service ecosystem or to the customers of their public transport service. This draws attention to the IT choice of German public transport companies in order to support citizens’ mobility behavior changes through the use of state-of-the-art IT, thus contributing to alleviate the mobility challenges caused by the extensive use of private cars. Specifically, we pose the following research questions:

RQ1: How does IT choice vary among the service ecosystems of German transport and tariff associations?

RQ2: What configurations of actors and of institutional arrangements in the service ecosystems of German transport and tariff associations are linked with the choice of state-of-the-art IT?

In this study, the focus is on the IT choice of German transport and tariff associations (TTAs) representing service ecosystems that encompass a high number of public transport companies (bus, subway, tram and train companies) and, in some cases, also one or more regional authorities (e.g., federal states, districts, or cities) acting as shareholders or funders (Reinhardt 2012). In other words, these service ecosystems are in part highly heterogeneous in terms of their actors, which may lead to different IT choices due to the varying rules, norms, and beliefs (so-called institutional arrangements (Vargo and Lusch 2017)) of their individual actors. In this context, Schulz et al. (2020a) show how varying institutional arrangements lead regional authorities to promote the choice of an app for the bundling of multiple mobility services, for instance with the goal of reducing air pollution caused by the predominant private car usage, while some public transport companies reject such an app for economic reasons. Hence, in addition to the presence of certain actors, the institutional arrangements that are established in a service ecosystem have an impact on IT choice of its actors.

To answer the research questions, we interviewed representatives from twelve German TTAs. Taking a service-dominant (S-D) logic perspective (Vargo and Lusch 2004) and considering the four information drives proposed by Watson et al. (2011), we identified attributes and attribute levels to characterize each service ecosystem with regard to its actors, institutional arrangements, and IT choice. Then we conducted a fuzzy-set qualitative comparative analysis (fsQCA) (Ragin 2008; Rihoux and Ragin 2009) to identify configurations of attribute levels for actors and institutional arrangements linked with the choice of state-of-the-art IT (e.g., provision of an app and availability of a mobile ticketing system). Our study contributes to the information systems (IS) and S-D logic literature, since research has rarely analyzed the IT choice in (mobility) service ecosystems and the related IT-enabled value co-creation (for an overview, see Brust et al. 2017), as underscored by Breidbach and Maglio (2016, p. 74): "We know very little about how economic actors engage in the process of value co-creation in traditional, co-located contexts […], let alone in technology-enabled ones".

Theoretical Background

Service-Dominant Logic Perspective

The service-dominant (S-D) logic perspective was initially adopted in marketing research (Vargo and Lusch 2004). Over time, scientific researchers from different fields (Hearn et al. 2007; Jarvis et al. 2014; Storbacka et al. 2016, etc.), in particular also from service science (e.g., Maglio et al. 2009; Spohrer and Maglio 2010) and IS research (Brust et al. 2017; Giesbrecht et al. 2017; Lusch and Nambisan 2015; Schulz et al. 2020a; b; Zimmermann et al. 2020, etc.) have adopted this perspective. In contrast to the goods-dominant (G-D) logic perspective, service is the basis of exchange between actors (Vargo et al. 2008), which is defined as "the application of resources for the benefit of others" (Vargo and Lusch 2017, p. 48). Each actor, particularly including the customer, participates in resource integration and service exchange (i.e., value co-creation) (Vargo and Lusch 2004; 2017). For instance, customers agree to permit a public transport company app to access location information in exchange for assistance navigating to the next station. Customers can also provide information on how crowded a subway, bus or train is, which the app relies on to provide high-quality recommendations to other customers (Nunes et al. 2014). Consequently, the principle of 'value-in-exchange' (G-D logic) is replaced by the principle of 'value-in-use' (Vargo and Lusch 2004), or, more recently, by 'value-in-context' (Vargo and Lusch 2017; Vargo et al. 2008).

The service-for-service exchange connects actors in a service ecosystem, which is defined as "a relatively self-contained, self-adjusting system of mostly loosely coupled social and economic (resource-integrating) actors connected by shared institutional logics [a synonym for institutional arrangements (Vargo and Lusch 2017)] and mutual value creation through service exchange" (Lusch and Nambisan 2015, p. 161. See Nischak et al. (2017) for varying definitions of an ecosystem and Spohrer et al. (2008) for a related definition of a service system). The central characteristics of a service ecosystem are thus (1) its actors and (2) the established institutional arrangements (attributes; marked in bold). The term **actor** is not limited to humans but also includes machines (Storbacka et al. 2016). A special feature of a service ecosystem is that its actors are simultaneously involved in multiple service ecosystems (Akaka et al. 2013; Schulz et al. 2020b; Schulz and Überle 2018). Public transport companies, for example, can be simultaneously embedded in the service ecosystem of a TTA and that of a third party provider of an app providing bundled mobility services (Schulz et al. 2020b).

Institutions reflect "humanly devised rules, norms, and beliefs that enable or constrain action" (Scott 2008; Vargo and Lusch 2017, p. 49), which North (1990, p. 3) also calls "the rules of the game". To date, our knowledge about institutions and **institutional arrangements** in service ecosystems and their effect on value co-creation is very limited (Vargo and Lusch 2017). Two of the first studies enriched the S-D logic perspective by applying institutional theory and analyzing how the institutional arrangements of a service ecosystem constrain the value co-creation by actors by negatively affecting IT used (Schulz et al. 2020a; Schulz and Überle 2018).

(3) "**IT**[s] drive the digitalization of business ecosystems and thereby enhance its functioning" (Nischak et al. 2017, p. 7). In this vein, Lusch and Nambisan (2015) argue that a service platform enables actors to conduct service-for-service exchange more effectively and efficiently. An example for a service platform is an app that allows customers to access information about different public transport services (e.g., ticket prices, arrival and departure times) or that provides information on the bundling of public transport and other mobility services (Schulz et al. 2020a; b; Zimmermann et al. 2020). According to Storbacka et al. (2016, p. 3010), the "actors [of a service ecosystem] need to be viewed not only as humans, but also as machines/technologies, or collections of humans and machines/technologies, including organizations".

Actors, Institutional Arrangements, and IT

In the following, we characterize the actors and the institutional arrangements that can be present in the service ecosystem of a German TTA by defining possible attribute levels (marked in italics). In addition, we develop propositions about how IT choice in TTA service ecosystems vary depending on the attribute levels of the actors and the institutional arrangements present in the service ecosystem. In developing propositions about IT choice, we draw on the concept of technology choice, which has been used in different research fields, such as economics (Gray and Shadbegian 1998; Inderst and Wey 2003, etc.), management (Goyal and Netessine 2007, etc.), production management (e.g., Drake et al. 2016), sustainability management (e.g., Hadjilambrinos 2000), and IS (Klischewski and Ukena 2009; Liu et al. 2013; Pollock and Williams 2006, etc.). Until recently, the concept of technology choice has primarily followed the G-D logic perspective, with a focus on the production and purchase of physical goods. For example, the work of Gray and Shadbegian (1998) is centered on the technology choice of paper mills, whereas Pollock and Williams (2006) investigate the procurement of a software package. However, the concept is also used in service contexts, such as in the electricity industry (Drake et al. 2016; Hadjilambrinos 2000).

Technology choice is not always an either-or decision. Power companies, for example, can chose among multiple technologies and use them simultaneously, generating power with solar, wind, and gas plants but not coal or nuclear power plants (Drake et al. 2016; Hadjilambrinos 2000). As emphasized by Drake et al. (2016), technology choice can also involve using varying combinations of different technologies. In the power company example, one company may choose a ratio of 30% solar, 20% wind, and 50% gas energy and another may choose a ratio of 15% solar, 15% wind, and 70% gas energy, and these ratios can, of course, change over time.

To date, the concept of technology choice has been used at the team (Pollock and Williams 2006; Sivunen and Valo 2006, etc.), company (e.g., Drake et al. 2016), network (e.g., Klischewski and Ukena 2009; Liu et al. 2013), and industry level of analysis (Gray and Shadbegian 1998; Hadjilambrinos 2000, etc.). This flexibility fits well with the S-D logic perspective, which acknowledges that actors are simultaneously embedded in multiple service ecosystems (Akaka et al. 2013; Schulz and Überle 2018). Afterwards, we present our propositions about the IT choice in the service ecosystems of German TTAs.

Proposition 1: A stronger involvement of a regional authority in a TTA service ecosystem is linked to the choice of state-of-the-art IT.

German TTAs are legally independent organizations (external view), but each of them also represents an intra-organizational service ecosystem including public transport companies and **regional authorities**, such as federal states, districts, or cities to varying degrees. A simple intra-organizational service ecosystem consists solely of *regional authorities* (1). In this case, the TTA is a corporation under public law, or a corporation under private law, in which the regional authorities are the sole shareholders and that tenders public transport. A different intra-organizational service ecosystem consists of *regional authorities* and *public transport companies* (2). Other intra-organizational service ecosystems are composed of *public transport companies* with a *cooperation agreement* with *regional authorities* (3). In other cases, the intra-organizational service ecosystem consists solely of *public transport companies* (4) (Knieps 2004;

Reinhardt 2012). As in previous cases, the public transport companies are partly in the hands of regional authorities[1]. We propose that intra-organizational service ecosystems with a stronger involvement of regional authorities are more inclined than other types of intra-organizational service ecosystems to choose state-of-the-art IT in order to make public transport more attractive. Schulz et al. (2020a) demonstrate a so-called 'green logic' for different German regional authorities that focuses on reducing the ecological footprint of mobility and on increasing its sustainability. Our proposition is also in line with Drake et al. (2016), who highlighted the contribution of policy (e.g., through investment subsidies) on the choice of clean technology.

Proposition 2: An advanced development stage of a TTA service ecosystem is linked to the choice of state-of-the-art IT.

According to Hadjilambrinos (2000), the technology choice of actors depends on the institutional structures influencing them. Similarly, the IT choice is not only influenced by the types of actors involved in a service ecosystem, but also by its institutional arrangements (Schulz et al. 2020a). We distinguish four attribute levels to characterize the **institutional arrangements** (rules, norms, and beliefs) that are present in the service ecosystems: Service ecosystems in the *differentiation stage* (1) carry out innovative projects (e.g., a test field for autonomous driving), which we think are linked to the choice of state-of-the-art IT. We assume that less and less state-of-the-art IT will be implemented in each of the following stages. Service ecosystems in the *maturity stage* (2) were established at least five years ago. The focus of its actors is on the adaptation of existing rules, for example, on the optimization of the tariff. In contrast, service ecosystems in the *growth stage* (3) are characterized by changes due to the current geographical enlargement of the activity area. Liu et al. (2013) highlight that the technology choices made by the actors in previously separate geographical areas can be highly heterogeneous, and thus affect interoperability. In the *pioneer stage* (4), the service ecosystems were only recently established and are focused on creating common rules – such as, the earnings allocation contracts.

Proposition 3: Availability of a high number of car-sharing actors is linked to the choice of state-of-the-art IT.

After the focus was on the respective TTA, we now expand the focus beyond its intra-organizational service ecosystem to include additional actors. One of these actors are the **car-sharing companies** operating in the same geographical area. Car-sharing has gained increasing popularity in recent years (Hildebrandt et al. 2015; Shaheen et al. 2009) and has the largest market share in the area of shared mobility in Germany (Hendzlik et al. 2016). However, Willing et al. (2016) show that car-sharing only partially complements public transport. In some cases, shorter travel times and higher level of comfort and convenience allow it to cannibalize demand for public transport. Goyal and Netessine (2007) illustrate that competition between companies impacts their technology choices. As a result, we assume that service ecosystem actors are more likely to choose state-of-the-art IT if they are in strong competition with car-sharing companies in order to offer a more convenient public transport service to (potential) customers. The strength of competition depends less on the number of car-sharing companies in the market than on the availability of the service, as reflected by the number of car-sharing vehicles (bsc Bundesverband CarSharing e.V. 2015). The argument that vehicles can be considered as actors is in line with the S-D logic literature (Storbacka et al. 2016). We define four attribute levels for the level of availability of car-sharing vehicles: *Commonly available* (1), *often available* (2), *mostly not available* (3), and *unavailable* (4).

Proposition 4: Involvement of an alternative mobility provider in a TTA service ecosystem is linked to the choice of state-of-the-art IT.

Compared to driving a private car, public transport has several shortcomings which make it less attractive. For example, public transport is a station-based service, the timetables are not flexible, and especially in the evening/night hours the service frequency is often relatively low, causing long waiting times (Beirão and Cabral 2007; Jorge and Correia 2013). As a result, customers are often forced to use additional mobility services (e.g., bike-sharing, car-sharing, and taxi) to get to and from the station, or to use solely these alternative mobility services. Currently, the prevailing opinion is that public transport is mostly not in competition with the service of **alternative mobility providers** (Caiati et al. 2020). Even in the case of

[1] With the exception of this discussion, the term 'public transport' is used throughout the work to describe a special type of mobility (e.g., subway, bus or train transport), regardless of whether it is provided by a private or public transport company (ownership structure).

car-sharing, it is expected that there is, besides the competitive effect (Proposition 3), a complementary effect (Caiati et al. 2020; Shaheen et al. 2009; Willing et al. 2017a). A service ecosystem of a TTA can make its own mobility services (e.g., bus and tram transport) more attractive by marketing them together with one or more alternative mobility services. For example, customers receive financial benefits compared to a separate purchase/booking or the entry fee of the car-sharing company is waived (Schulz et al. 2020b). Such a cooperation does not necessarily require the use of state-of-the-art IT. However, the common offers of both actors are particularly attractive and convenient for customers if, for instance, integrated ticketing through an app is provided (Schulz et al. 2018). In summary, we assume that the *involvement* (1) of an alternative mobility provider – in contrast to the case of *non-involvement* (2) – is linked to the choice of state-of-the-art IT.

Definition of State-of-the-Art IT

The IT choices made by the actors of a TTA service ecosystem, for example concerning an app and a mobile ticketing system, can be classified on an aggregated level as the choice of state-of-the-art IT or not state-of-the-art IT. On the lower level, several attribute levels must be defined for the individual IT to take account of the heterogeneity of the chosen IT. Our approach is identical to the known procedure of characterizing actors and institutional arrangements present in a specific TTA service ecosystem. Schulz et al. (2020a; b) show how the use of not state-of-the-art IT has a negative impact on the value co-creation of actors in a mobility service ecosystem. As a result of choosing not state-of-the-art IT, in particular the four information drives of (potential) customers – ubiquity, uniqueness, unison, and universality (Watson et al. 2011) – are not satisfied by the service offered by a TTA and its public transport companies. Watson et al. (2011, p. 56) argue that "most people in advanced economies have become so habituated to the fulfillment of their fundamental information drives that, if we are to change their behaviors in the direction of greater ecological sustainability [i.e., away from private car use to the use of public transport], we need to be highly conscious of feeding these drives". Based on this theoretical foundation, we derive four types of IT (an app, equipment for the provision of real-time timetable data, a mobile ticketing system, and a smart mobility platform), which we use to assess whether a state-of-the-art IT has been chosen by the actors.

The first information drive, 'ubiquity', is defined as "access to information unconstrained by time and space" (Junglas and Watson 2006, p. 578). Widespread diffusion of smartphones offers an unprecedented opportunity to provide extensive information about public transport services, such as timetable data and ticket prices, so that customers can explore their mobility options (Watson et al. 2011; Zimmermann et al. 2020). Some apps provide customers with some information without an active internet connection (Mayer 2012). This circumstance makes the presence of an **app** to the first attribute of IT choice that comprises two possible attribute levels: *available* (1), or *unavailable* (2).

'Uniqueness' involves knowing "precisely the characteristics and location of a person or entity" (Junglas and Watson 2006, p. 579). IT that provides such information allows customers to find vehicles (buses, trains, etc.), which best match their unique mobility need. Whereas customers' location is accessible via their smartphone, public transport companies can use equipment like sensors to locate vehicles and track delays or failures (Schreieck et al. 2018; Schulz et al. 2020b). Hence, the availability of technical **equipment for the provision of real-time timetable data** is the second attribute of IT choice. Depending on the availability of real-time timetable data for vehicles, the following attribute levels can be distinguished: *Commonly available* (1), *often available* (2), *mostly not available* (3), and *unavailable* (4).

'Unison', is defined as "the drive for information consistency" (Junglas and Watson 2006, p. 580). Drawing on Watson et al. (2011), customers want a single view of all information related to a mobility service. For example, an app can not only inform the customers about the timetables of different public transport companies, but can also provide information for the ticket purchase (tariffs, points of sale, etc.). An even higher level of informational unison is reached if customers are also shown the individual price for their planned trip, taking into account, for instance, the number of tariff zones required, and are given the option to buy a ticket (Li et al. 2009; Zimmermann et al. 2020). Hence, the presence of **mobile ticketing** is a further attribute of IT choice. The possible attribute levels are *available* (1), and *unavailable* (2).

'Universality' is characterized by the need "to overcome the friction of information systems' incompatibilities" (Junglas and Watson 2006, p. 580) that exist, for example, when customers need to use apps from several mobility providers simultaneously. A TTA as keystone organization of the service ecosystem bridges the formerly separate IT solutions of the individual public transport companies by providing customers a common timetable information and/or mobile ticketing. Incompatibilities can be reduced even further if a TTA allows its customers to bundle public transport with other mobility services, such as taxi, bike-sharing, or ride-sharing, to get from origin to destination (Schulz et al. 2020b). In this case, a **smart mobility platform** (service platform) constitutes the technical heart of the service ecosystem (Schreieck et al. 2018; Willing et al. 2017a; b) and a further attribute of IT choice. Depending on its current technical status, four attribute levels can be differentiated in the range: *fully operational* (1), *implementation* (2), *planning* (3), *no approach* (4). Our theoretical considerations are summarized in Figure 1.

Attributes for the actors and the institutional arrangements	Attribute level
Regional authority	Solely involved in the TTA
Development stage	Differentiation stage
Car-sharing actors	Commonly available
Alternative mobility provider	Involvement

Fit

Attribute level	Attributes for the IT choice
Available	App
Commonly available	Equipment for real-time timetable data
Available	Mobile ticketing
Fully operational	Smart mobility platform

Figure 1. Expected Configuration of Attribute Levels, Which Characterize the Actors and Institutional Arrangements of a TTA Service Ecosystem That Are Linked to the Choice of State-of-the-Art IT.

Methodology

Qualitative Interviews

We collected data from German TTAs. In 2017, more than 10 billion trips were taken on German public transport. However, the public transport companies were often unprofitable and regional authorities had to provide financial support to ensure public transport service (Verband Deutscher Verkehrsunternehmen 2018). At the beginning of our study, there were approximately 124 TTAs (Reinhardt 2012; Wikipedia 2016). A theoretical sampling approach was used (Flick 2009; Glaser and Strauss 1967) to select 45 TTAs that vary with regard to the number of associated public transport companies and number of passengers per year. We contacted the managing director (MD) to request an interview. We collected data through interviews because personal interaction leaves room to ask for background information and eliminate ambiguities. Taking a snowball sampling approach (e.g., Su 2013), we asked the managing director to identify further or more appropriate internal experts, such as a project manager (PM) for a smart mobility platform, an office manager (OM), an authorized representative (AR), or a person who carries out the transport planning (TP). Overall, we received interview confirmations from twelve TTAs, three offered interviews with two representatives.

We conducted the interviews using a semi-structured interview guideline (Yin 2014), probing business-related and technical topics like the degree of involvement of a regional authority, and the current status of the smart mobility platform. The guideline was continually adapted to fill gaps that emerged during analysis. We also collected secondary data from the website of each TTA and other publicly available data sources (e.g., association reports, press releases) to supplement our interview data and to permit data triangulation (Flick 2009; Miles et al. 2014). We also drew on an official publication about the availability of car-sharing in Germany (bsc Bundesverband CarSharing e.V. 2015). The interviews started at the end of 2016 and lasted on average 66 minutes. All interviews were recorded and transcribed.

We used the software NVivio 10 to code our data. Using an iterative coding approach (Strauss and Corbin 1998), one member of the research team initially analyzed the data parallel to data collection. The coding categories were identical to the attributes and attribute levels, characterizing the service ecosystem of a TTA, including its IT choice. In a second round of analysis, the codes of each entity were related to each other (Miles et al. 2014). The other members of the research team cross-checked the results to minimize potential coding bias. In addition, the research team discussed the (preliminary) results at regular meetings to reach a common interpretation of the results.

Fuzzy-Set Qualitative Comparative Analysis (fsQCA)

We then analyzed the coded data material using fsQCA. Originally introduced in sociological and political science, QCA and the more fine-grained fsQCA have gained popularity in other research fields like IS (e.g., Müller et al. 2017; Park et al. 2017; Rivard and Lapointe 2012; for an overview, see Soto Setzke et al. 2020; Zimmermann et al. 2020), service science (e.g., Ordanini et al. 2014), as well as management (Fiss 2011; Kan et al. 2016, etc.). It is appropriate to use fsQCA in our study, because we assume that only the analysis of configurations of multiple attributes and their attribute levels that characterize a service ecosystem can explain the IT choice of its actors. For instance, Park et al. (2017) similarly examine how the effect of IT on the organizational agility depends on the configuration of different organisational and environmental attributes. This is an important distinctive feature from traditional regressions-based models that are used to analyze the net effect of each factor on the outcome. Two further features of QCA are the concept of equifinality, this means that different configurations can lead to the identical outcome, and the assumption that the relationships between the attribute levels and the outcome are not necessarily symmetrical. In other words, in contrast to traditional regressions-based models, where a factor is both a necessary and sufficient condition for an outcome, an attribute level may be a necessary or a sufficient condition for an outcome (Soto Setzke et al. 2020).

Applying the fsQCA based on the data generated from the interviews with the twelve TTAs meets the requirements of the method. QCA is especially applicable to research designs with a medium number of cases (from 10 to 50 cases), which applies in our study (Schneider and Wagemann 2007). Some studies, however, also analyze fewer than ten cases (for an overview, see Buche and Siewert 2015). In contrast, based on their analysis of the use of the QCA in the IS field, Soto Setzke et al. (2020) show that in previous research predominantly large-N analyzes (50+) were conducted, which limits some of the key capabilities of the method, such as orientation based on in-depth case knowledge. Small-N analyzes as in our study do not necessarily aim at generalizing the results and therefore do not require the examination of the entire population or a representative sample. Instead, "a combination of "positive cases" that display the outcome and "negative cases" that could be expected to display the outcome but do not" (Greckhamer et al. 2018, p. 488) can be used. In the run-up to the study, the IT choice in the service ecosystem of each German TTA was unknown. However, as a result of our theoretical sampling approach, the selected TTAs vary with regard to the number of associated public transport companies and of passengers per year (a measure of the number of customers). In other words, the cases represent service ecosystems with varying sizes, as typical for German TTAs, to base our fsQCA on a suitable combination of empirical cases. An overview of these key figures is published in Schulz et al. (2018).

fsQCA is a set-theoretic method of empirically analyzing the relationship between an outcome and all possible configurations of attribute levels with the aim of identifying necessary and sufficient conditions using Boolean algebra (Ragin 2008). Hence, the "analysis focuses on set relations rather than on correlations" (Rivard and Lapointe 2012, p. 901). In the following, we explain fsQCA as a four-step approach as illustrated by Fiss (2011) and Ordanini et al. (2014): (1) fsQCA starts with a **definition of the property space**. It comprises all theoretically possible configurations of attribute levels and "delimits potential explanations of the outcome", which is why the attributes and their attribute levels "should be chosen carefully and anchored in extant theoretical knowledge" (Ordanini et al. 2014, p. 137). Accordingly, we identified these on the basis of literature from different disciplines (as can be seen in the theoretical background section). In general, fsQCA assumes that each attribute has only two attribute levels – an attribute is present or not present. The attribute levels are abbreviated as follows: *strong involvement* of a *regional authority* (IRA), the TTA service ecosystem is in an *advanced development stage* (ADS), availability of a *high number* of *car-sharing actors* (HCA), and *involvement* of an *alternative mobility provider* (IMP). A comparison of the ratio of the number of empirical cases and selected attributes in previous IS studies is provided by Soto Setzke et al. (2020). The present ratio of twelve to four can be regarded as an example of good practice. The property space includes all possible configurations, therefore also configurations where one or more attribute are absent. For instance, when there is *no* involvement of an alternative mobility provider. Compliant with commonly applied QCA usage (Müller et al. 2017; Park et al. 2017, etc.), we use the tilde sign (e.g., ~IMP) to indicate such attribute levels. In total, $2^4 = 16$ theoretically possible configurations exist.

(2) The second step is the **development of set-membership measures**. A set corresponds to a configuration of attribute levels and is depicted in binary format. To account for the fact that the empirical data material is largely not dichotomous, we evaluated the extent to which a service ecosystem is a member

of the different dichotomous sets using a crisp set (1 = ‘fully in’, and 0 = ‘fully out’), and a four-value fuzzy set with the following membership scores: 1 = ‘fully in’, 0.67 = ‘more in than out’, 0.33 = ‘more out than in’, and 0 = ‘fully out’ (Rihoux and Ragin 2009). Based on the coding results, one of these membership scores is assigned to each attribute of each empirical case. For instance, the TTA of PM2 consists solely of regional authorities. Hence, in line with the proposition 1, the membership score 1 = ‘fully in’ is assigned. The result is depicted in Table 1. In addition, the membership scores 1 and 0.67 are assigned, for example, IRA, whereas 0 and 0.33 are allocated to ~IRA. Based on the membership scores of a TTA service ecosystem for each attribute, we also can determine the membership scores for every configuration because a service ecosystem owned a membership measure greater than 0.5 in only one configuration. In our sample, two configurations are represented through more than one empirical cases (see Table 5 in the Appendix).

ID	IRA	ADS	HCA	IMP	Choice of state-of-the-art IT (outcome set)			
					APP	RTD	MT	SMP
MD1	0.67	1	1	1				
MD2	0.67	0.67	1	1				
MD3	0	0.33	0.67	1				
MD4	0.67	0.67	0.33	1				
MD5	0	0.67	0.33	1				
MD6/TP1	0.33	0	0.33	0		***See Table 2***		
MD7	1	0.33	0	0				
MD8/PM1	1	0.33	0	0				
AR1/TP2	1	0	0.67	0				
OM1	0.67	0.67	0	0				
PM2	1	1	1	1				
PM3	1	1	1	1				

Table 1. Membership Scores for the Causal Sets.

(3) The third step is the **evaluation of consistency**. The consistency measure of an individual attribute level must exceed a threshold of 0.9 to be accepted as a necessary condition (Schneider and Wagemann 2007; Soto Setzke et al. 2020). In order to determine the sufficient conditions, we evaluate the consistency in set relations by conducting a cross-case comparison between the configurations of attribute levels (causal sets) and the choice of state-of-the-art IT (outcome set). Ragin (2008) as well as Rihoux and Ragin (2009) recommend a minimum consistency threshold of 0.75. Deviating from this, we applied a more restrictive threshold of 0.80. In line with the QCA literature (Rihoux and Ragin 2009; Soto Setzke et al. 2020), we included all configurations in the analysis that mirrored at least one empirical case.

(4) Finally, we made a **logical reduction**, “to prune the sufficient configurations by eliminating redundant elements” (Ordanini et al. 2014, p. 139). The final result depends heavily on the treatment of so-called remainders, which are theoretically possible configurations not present in the empirical data. In our study, there is at least one empirical case for eight of the sixteen theoretically possible configurations. This ratio can be regarded as sufficiently high. Based on the review of QCA studies, Buche and Siewert (2015) reported on studies in which no empirical case exists for more than 90 percent of the theoretically possible configurations. To avoid simplifying assumptions during the logical reduction, we do not use the remainders (so-called complex solution). Therefore, no counterfactual cases are possible (Ragin 2008).

We used the fs/QCA 3.0 software for our analysis, which uses the Quine-McCluskey algorithm to simplify the Boolean expressions (Schneider and Wagemann 2007). According to Soto Setzke et al. (2020), the fs/QCA software is the most frequently used software in QCA studies in the IS field. The quality of the solution can be considered high if the value of the solution consistency is in the range from 0.75 to 1.00. With regard to the value of the solution coverage there is no fixed range, but values between 0.05 and 0.46, which were reported in previous IS studies, are considered rather low (Soto Setzke et al. 2020).

Results

Choice of State-of-the-Art IT (Outcome Set)

Our interviews revealed that eight of twelve TTA service ecosystems provide customers with information such as timetables and ticket prices using an **app**. In some cases, the app is *available* through the TTA (e.g., MD1, MD2, AR1), while in other cases one of the public transport companies provides the app (MD3, MD8, etc.). The results are presented in Table 2, using the crisp and four-value fuzzy set measures. The last column depicts the values for the outcome set for our fsQCA, more precisely for the choice of state-of-the-art IT, which are derived from the results shown in the columns two to five. By contrast, in four TTA service ecosystems an app is *unavailable* to customers. For instance, in the case of MD6 and MD7, customers get the information on a website, whereas OM1 expected the implementation of a "timetable and price information in the next year".

ID	**App (APP)**	**Equipment for real-time timetable data (RTD)**	**Mobile ticketing (MT)**	**Smart mobility platform (SMP)**	**Choice of state-of-the-art IT** (outcome set)
MD1	1	1	1	0.67	**0.67**
MD2	1	1	1	0.67	**0.67**
MD3	1	0.67	1	0.33	**0.67**
MD4	1	0.67	0	0	**0.33**
MD5	0	0.33	1	0.33	**0.33**
MD6/TP1	0	0	0	0	**0**
MD7	0	0.33	0	0.33	**0**
MD8/PM1	1	0.67	0	0.33	**0.33**
AR1/TP2	1	0.67	0	0.33	**0.33**
OM1	0	0.33	0	0	**0**
PM2	1	0.33	1	0.67	**0.67**
PM3	1	1	1	0.67	**0.67**

Table 2. Membership Scores for the Outcome Set (Choice of State-of-the-Art IT).

With regard to the availability of **real-time timetable data**, our analysis revealed a more differentiated result. Only three interviewees (MD1, MD2, PM3) indicated that real-time timetable data is *commonly available* for their public transport companies. In the case of the great majority of TTA service ecosystems, real-time timetable data is *often available* or *mostly not available*. For example, "approximately 70% of public transport is covered" (MD4), and "real-time timetable data […] is available. However, the data is not comprehensive enough to achieve something with it" (OM1). By contrast, TP1 stated that "at the moment, [real-time timetable data] is *unavailable*".

An equally fragmented picture emerged with regard to the availability of **mobile ticketing**. In half of the service ecosystems, a common mobile ticketing is *available* by the TTA itself (MD1, MD2, PM2, PM3), or by one of the public transport companies (MD3, MD5). The actors also use chip card-based tickets either supplementary to (e.g., PM3), or, in some cases, as the unique non-paper-based ticketing solution (MD6, MD8). Because customers must purchase a chip-card and credit ahead of time, such a solution cannot be considered truly state-of-the-art.

There are big differences with regard to the technical status of the **smart mobility platform** that the TTA service ecosystems provide for the bundling of public transport with other mobility services. In no case does the TTA provide a mobility platform that is *fully operational*. A handful of interviewees reported that the TTA is working on *implementing* a smart mobility platform (MD1, MD2, PM3, etc.). As MD1 pointed out, not without some pride, "we are on the home stretch in terms of multimodal information. […]. We are [also] working intently to ensure that customers receive a single mobility bill at the end of the month". Similarly, the TTA of PM3 enables its customers "to access information about available car-sharing vehicles and rental bikes as well as to book them". However, other mobility services are not available – "we would also like to integrate mobility services, such as [...], ride-sharing, etc." (PM3). Several TTAs (e.g., MD5, MD8) are in the early *planning* stage, asking "what do we want to integrate further into our timetable information? Car-sharing, or bike-sharing, or so?" (AR1), or trying "to determine the need" (MD7). Other TTAs have *no* smart mobility platform *approach* (MD4, MD6, OM1). In conclusion, while the number of public transport companies associated with a TTA has no influence on IT choice, most TTAs with a high number of customers have state-of-the-art IT.

(Configurations of) Attribute Levels Characterizing the Actors and Institutional Arrangements Linked to the Choice of State-of-the-Art IT

Based on the presented results, our fsQCA provides the attribute levels as well as their configurations which characterize the actors and institutional arrangements of the TTA service ecosystems linked to the choice of state-of-the-art IT (outcome set). In line with the procedure described by Schneider and Wagemann (2007), the results for the analysis of the necessary conditions are depicted in Table 3. Only in the case of one attribute level (HCA) the consistency value (0.929) exceeds the recommended threshold of 0.9 (Schneider and Wagemann 2007; Soto Setzke et al. 2020). In other words, the availability of a high number of car-sharing actors in the specific geographical area is linked to the choice of state-of-the-art IT by the actors of a TTA service ecosystem.

Attribute level	**Consistency**	**Coverage**	**Attribute level**	**Consistency**	**Coverage**
IRA	0.786	0.458	~IRA	0.426	0.499
ADS	0.857	0.600	~ADS	0.497	0.435
HCA	***0.929***	***0.686***	~HCA	0.353	0.291
IMP	0.859	0.573	~IMP	0.141	0.132

Table 3. Necessary Conditions for the Choice of State-of-the-Art IT.

In addition, we analyzed the sufficient conditions (i.e., configurations of attribute levels) for the choice of state-of-the-art IT. As Table 4 shows, our result achieves a solution coverage of 0.859, and an identical value for solution consistency. Compared to previous QCA studies (Ganter and Hecker 2014; Ordanini et al. 2014; Soto Setzke et al. 2020) both values can be considered high. A solution coverage of just over 85% indicates that there are only a small number of further configurations of attribute levels that are also linked to the choice of state-of-the-art IT but that do not reach the consistency threshold.

Sufficient sets	**Raw coverage**	**Unique coverage**	**Consistency**
IRA*ADS*HCA*IMP	0.645	0.503	0.820
~IRA*~ADS*HCA*IMP	0.355	0.214	1.000
Solution coverage: 0.859			
Solution consistency: 0.859			

Table 4. Sufficient Conditions for the Choice of State-of-the-Art IT.

Table 4 illustrates that two configurations of attribute levels go along with the choice of state-of-the-art IT with sufficient consistency. The solution in the first row (IRA*ADS*HCA*IMP) states that 82% of the TTA service ecosystems characterized by a strong involvement of a regional authority (IRA), an advanced development stage (ADS), the availability of a high number of car-sharing actors (HCA), and an involvement of an alternative mobility provider (IMP) are members of the outcome set (choice of state-of-the-art IT). According to the second row, the configuration ~IRA*~ADS*HCA*IMP – *no* involvement of a regional authority (~IRA), *no* advanced development stage (~ADS), the availability of a high number of car-sharing actors (HCA), as well as an involvement of an alternative mobility provider (IMP) is also linked with the choice of state-of-the-art IT. In this case the consistency is 1, which means that all TTA service ecosystems of the sample with such a configuration of attribute levels have chosen state-of-the-art IT. Considering the raw coverage, the first configuration accounts for 64%, and the second configuration for 36% of the cases related to the choice of state-of-the-art IT.

Discussion and Conclusion

This section discusses the results and implications of our study. The two primary goals were to determine the IT choice in the service ecosystem of different German TTAs (RQ1), as well as to identify the attribute levels and configurations of attribute levels which characterize the actors and institutional arrangements of these service ecosystems linked to the choice of state-of-the-art IT (RQ2). To achieve these goals, we adopted an S-D logic perspective (Vargo and Lusch 2004; 2017) and conducted a fsQCA (Ragin 2008; Rihoux and Ragin 2009) of data collected in interviews.

To date, little IS research has applied the S-D logic perspective in a mobility context (for an overview, see Brust et al. 2017). Previous studies (e.g., Schulz et al. 2020b) focus on the concept of value co-creation and how value co-creation can be improved between the individual actors of one or more service ecosystems. However, little has been known about how the presence of specific actors and institutional arrangements influence the IT choice of its actors, and thus their value co-creation (Schulz et al. 2020a; b; Schulz and Überle 2018). Hence, this study contributes to S-D logic and IS literature first by focusing on the service ecosystem of different German TTAs. Our generic conceptualization builds on the definition established by Lusch and Nambisan (2015) that highlights (1) the actors and (2) the institutional arrangements as essential parts of service ecosystems. Subsequently, drawing on previous literature (e.g., Caiati et al. 2020; Reinhardt 2012; Schulz et al. 2020a; b), we identified different actors (which represent attributes) that may be present in the service ecosystem of a TTA. Because these service ecosystems are very heterogeneous in practice, our classification relies on multiple attribute levels. We followed the same approach with regard to institutional arrangements (Vargo and Lusch 2017). The resulting generic conceptualization of the service ecosystem of German TTAs can be used in future research and the adopted approach can serve as a blueprint for the conceptualization of other (mobility) service ecosystems.

Second, we contribute to the S-D logic literature (Vargo and Lusch 2004; 2017) by introducing the concept of technology choice (Goyal and Netessine 2007; Gray and Shadbegian 1998; Liu et al. 2013, etc.). Based on Nischak et al. (2017) and Lusch and Nambisan (2015), we argue that (3) the IT chosen by the actors of a service ecosystem is a further attribute in its conceptualization. Drawing on the literature on technology choice, we made four propositions about how the presence of a certain actor or type of institutional arrangements is linked to the choice of state-of-the-art IT. To identify the relevant IT, we relied on the information drives (Watson et al. 2011) that must be satisfied by the chosen IT to change the behaviour of citizens towards the use of public transport. For the individual IT (e.g., app, mobile ticketing), we define several attribute levels, which allow the IT choice to be classified as not- or state-of-the-art IT on the aggregated level. Based on the fsQCA of data collected in qualitative interviews, our results show that a focus on the different configurations of service ecosystems (i.e., on their actors, institutional arrangements, and IT choice) can lead to a better understanding of IT-enabled value co-creation (Breidbach and Maglio 2016).

Thirdly, our study illustrates the suitability of fsQCA (Ragin 2008; Rihoux and Ragin 2009; Schneider and Wagemann 2007), which has only recently enjoyed a certain popularity in IS research to analyze service ecosystem-related issues. Previous IS research primarily relies on traditional regressions-based models which, in contrast, analyze the net effect of each factor on the outcome (Soto Setzke et al. 2020). Hence, by contributing to the dissemination of fsQCA, we therefore pave the way for new insights into service ecosystems. Our fsQCA-results show, for instance, that regardless of the development stage of a TTA service ecosystem (ADS or ~ADS), its actors choose state-of-the-art IT if certain other attribute levels are present. Thus, we contribute to the emerging literature on institutional arrangements in service ecosystems (Vargo and Lusch 2017), especially in a mobility context (e.g., Schulz et al. 2020a; Schulz and Überle 2018). For researchers, our results illustrate the need to consider the customer in determining the analysis focus for nested service ecosystems (Akaka et al. 2013; Schulz et al. 2020b; Schulz and Überle 2018). To fill a complex (mobility) need, customers are the link between service providers embedded in different service ecosystems when they gather information about available services and, for example, compare public transport and car-sharing services. Our results show that the choice of state-of-the-art IT by the actors of the TTA service ecosystems is linked to the availability of a high number of car-sharing actors in the geographical area, possibly in response to the competitive situation (Willing et al. 2016).

Our study has practical implications, especially for policy makers. Our results illustrate that none of the TTA service ecosystems chose the most advanced IT with regard to all four types of IT analyzed and that their overall IT choices vary greatly (see Table 2). This makes it difficult for third party smart mobility platform providers (Albrecht and Ehmke 2016; Willing et al. 2017a; b) to integrate IT and provide smart mobility across the geographical areas of multiple TTAs. In addition, to better fulfill the information drives of potential customers, and thus support behavior change towards using public transport (Watson et al. 2011), most TTA service ecosystems need to invest in state-of-the-art IT. Our study shows that availability of a high number of car-sharing actors (HCA), as reflected by the number of car-sharing vehicles, is linked to the choice of state-of-the-art IT. Hence, regardless of their level of involvement in a TTA, regional authorities should thus improve the market environment for car-sharing companies, for example by reserving more parking spaces to car-sharing vehicles. To further reduce air and noise pollution, regional authorities should prioritize electric car-sharing vehicles (bsc Bundesverband CarSharing e.V. 2018), for example by providing more charging stations. The two identified sufficient conditions for the choice of state-of-the-art IT (IRA*ADS*HCA*IMP, and ~IRA*~ADS*HCA*IMP) have further practical implications. In particular, the high degree of raw coverage of the first solution underscores the value of increased involvement of regional authorities (IRA) in the intra-organizational service ecosystem of TTAs (Knieps 2004; Reinhardt 2012).

Our study has some limitations, which point to the need for future research: (1) First, we offered only a limited perspective on the IT choice of each TTA service ecosystem by focusing primarily on regional authorities and mobility providers. This supply-side perspective aligns well with recent discussion how to make public transport more attractive to potential customers and about to what degree TTAs and their public transport companies can currently contribute to the realization of smart mobility platforms (Albrecht and Ehmke 2016; Schulz et al. 2020b; Willing et al. 2017a; b). However, our results indicate that also attributes and attribute levels that can be used in characterizing (potential) customers (e.g., number of passengers) can additionally help explain the IT choice of TTAs. Furthermore, the actors already included in the analysis can be further specified in order to gain deeper insights. For example, the level of subsidies received by the public transport companies from the regional authorities may be taken into account. (2) In addition, we only collected data from twelve TTAs, which limits the generalizability of the results. From a methodological standpoint, our study exceeds the minimum case number necessary to conduct a fsQCA (Buche and Siewert 2015; Schneider and Wagemann 2007; Soto Setzke et al. 2020). Nonetheless, future studies should collect data from a representative sample or from the entire population. (3) Lastly, IT choice in mobility service ecosystems in other countries should be examined in order to further increase the generalizability of the results.

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References

Akaka, M. A., Vargo, S. L., and Lusch, R. F. 2013. "The Complexity of Context: A Service Ecosystems Approach for International Marketing," *Journal of International Marketing* (21:4), pp. 1-20.

Albrecht, L., and Ehmke, J. F. 2016. "Innovative Services in der Mobilitätsbranche: Eine Marktanalyse multimodaler Mobilitätsmanager," *Multikonferenz Wirtschaftsinformatik*, Ilmenau.

Beirão, G., and Cabral, J. A. S. 2007. "Understanding Attitudes Towards Public Transport and Private Car: A Qualitative Study," *Transport Policy* (14), pp. 478-489.

Belk, R. 2014. "You Are What You Can Access: Sharing and Collaborative Consumption Online," *Journal of Business Research* (67:8), pp. 1595-1600.

Benevolo, C., Dameri, R. P., and D'Auria, B. 2016. "Smart Mobility in Smart City: Action Taxonomy, ICT Intensity and Public Benefits," in *Empowering Organizations: Enabling Platforms and Artefacts,* T. Torre, A. M. Braccini and R. Spinelli (eds.), Cham: Springer, pp. 13-28.

Breidbach, C. F., and Maglio, P. P. 2016. "Technology-Enabled Value Co-Creation: An Empirical Analysis of Actors, Resources, and Practices," *Industrial Marketing Management* (56), pp. 73–85.

Brust, L., Breidbach, C. F., Antons, D., and Salge, T. O. 2017. "Service-Dominant Logic and Information Systems Research: A Review and Analysis Using Topic Modeling," *International Conference on Information Systems*, Seoul.

bsc Bundesverband CarSharing e.V. 2015. "Bcs-Städtevergleich 2015: Carsharing-Angebote in deutschen Städten über 50.000 Einwohner." Retrieved 2017-06-02, from https://carsharing.de/sites/default/files/.../uebersichtstabelle_staedteranking_2015.pdf

bsc Bundesverband CarSharing e.V. 2018. "Die Förderung des Bundesverkehrsministeriums für das E-Carsharing ist realitätsfern." Retrieved 2018-10-26, from https://www.carsharing.de/presse/pressemitteilungen/foerderung-des-bundesverkehrsministeriums-fuer-e-carsharing-ist

Buche, J., and Siewert, M. B. 2015. "Qualitative Comparative Analysis (QCA) in der Soziologie – Perspektiven, Potentiale und Anwendungsbereiche," *Zeitschrift für Soziologie* (44:6), pp. 386-406.

Caiati, V., Rasouli, S., and Timmermans, H. 2020. "Bundling, Pricing Schemes and Extra Features Preferences for Mobility as a Service: Sequential Portfolio Choice Experiment," *Transportation Research Part A: Policy and Practice* (131), pp. 123-148.

Drake, D. F., Kleindorfer, P. R., and van Wassenhove, L. N. 2016. "Technology Choice and Capacity Portfolios under Emissions Regulation," *Production and Operations Management* (25:6), pp. 1006-1025.

Fiss, P. C. 2011. "Building Better Causal Theories: A Fuzzy Set Approach to Typologies in Organization Research," *Academy of Management Journal* (54:2), pp. 393-420.

Flick, U. 2009. *An Introduction to Qualitative Research*. London: SAGE Publications.

Ganter, A., and Hecker, A. 2014. "Configurational Paths to Organizational Innovation: Qualitative Comparative Analyses of Antecedents and Contingencies," *Journal of Business Research* (67:6), pp. 1285-1292.

Giesbrecht, T., Schwabe, G., and Schenk, B. 2017. "Service Encounter Thinklets: How to Empower Service Agents to Put Value Co-Creation into Practice," *Information Systems Journal* (27:2), pp. 171-196.

Giesecke, R., Surakka, T., and Hakonen, M. 2016. "Conceptualising Mobility as a Service: A User Centric View on Key Issues of Mobility Services," *Conference on Ecological Vehicles and Renewable Energies*, Monte Carlo, pp. 1-11.

Glaser, B. G., and Strauss, A. L. 1967. *The Discovery of Grounded Theory: Strategies for Qualitative Research*. New York: Aldine de Gruyter.

Goyal, M., and Netessine, S. 2007. "Strategic Technology Choice and Capacity Investment under Demand Uncertainty," *Management Science* (53:2), pp. 192-207.

Gray, W. B., and Shadbegian, R. J. 1998. "Environmental Regulation, Investment Timing, and Technology Choice," *Journal of Industrial Economics* (46:2), pp. 235-256.

Greckhamer, T., Furnari, S., Fiss, P. C., and Aguilera, R. V. 2018. "Studying Configurations with Qualitative Comparative Analysis: Best Practices in Strategy and Organization Research," *Strategic Organization* (16:4), pp. 482-495.

Hadjilambrinos, C. 2000. "Understanding Technology Choice in Electricity Industries: A Comparative Study of France and Denmark," *Energy Policy* (28:15), pp. 1111-1126.

Hearn, G., Roodhouse, S., and Blakey, J. 2007. "From Value Chain to Value Creating Ecology: Implications for Creative Industries Development Policy," *International Journal of Cultural Policy* (13:4), pp. 419-436.

Hendzlik, M., Howe, E., and Steiner, J. 2016. "Shared Mobility," *Internationales Verkehrswesen* (2:68), pp. 11-13.

Hildebrandt, B., Hanelt, A., Piccinini, E., Kolbe, L. M., and Nierobisch, T. 2015. "The Value of IS in Business Model Innovation for Sustainable Mobility Services - the Case of Carsharing," *International Conference on Wirtschaftsinformatik*, Osnabrück.

Inderst, R., and Wey, C. 2003. "Bargaining, Mergers, and Technology Choice in Bilaterally Oligopolistic Industries," *RAND Journal of Economics* (34:1), pp. 1-19.

Jäppinen, S., Toivonen, T., and Salonen, M. 2013. "Modelling the Potential Effect of Shared Bicycles on Public Transport Travel Times in Greater Helsinki: An Open Data Approach," *Applied Geography* (43), pp. 13-24.

Jarvis, W., Halvorson, W., Sadeque, S., and Johnston, S. 2014. "A Large Class Engagement (LCE) Model Based on Service-Dominant Logic (SDL) and Flipped Classrooms," *Education Research and Perspectives* (41), pp. 1-24.

Jorge, D., and Correia, G. 2013. "Carsharing Systems Demand Estimation and Defined Operations: A Literature Review," *European Journal of Transport and Infrastructure Research* (13:3), pp. 201-220.
Junglas, I., and Watson, R. T. 2006. "The U-Constructs: Four Information Drives," *Communications of the Association for Information Systems* (17), pp. 569-592.
Kan, A. K. S., Adegbite, E., El Omari, S., and Abdellatif, M. 2016. "On the Use of Qualitative Comparative Analysis in Management," *Journal of Business Research* (69:4), pp. 1458-1463.
Klischewski, R., and Ukena, S. 2009. "A Value Network Analysis of Automated Access to E-Government Services," *International Conference on Wirtschaftsinformatik*, Wien.
Knieps, M. 2004. "Aufgabenträger oder Verkehrsunternehmen als Gesellschafter von Verkehrsverbünden? - Eine Analyse bestehender Verbundstrukturen und eine Bewertung unterschiedlicher Organisationsmodelle unter institutionenökonomischen Gesichtspunkten." Gießen: Justus-Liebig-Universität Gießen.
Li, T., van Heck, E., and Vervest, P. 2009. "Information Capability and Value Creation Strategy: Advancing Revenue Management through Mobile Ticketing Technologies," *European Journal of Information Systems* (18:1), pp. 38-51.
Liu, Y., Guo, H., and Nault, B. R. 2013. "Technology, Interoperability, and Provision of Public Safety Networks," *International Conference on Information Systems*, Milan.
Lusch, R. F., and Nambisan, S. 2015. "Service Innovation: A Service-Dominant Logic Perspective," *MIS Quarterly* (39:1), pp. 155-175.
Maglio, P. P., Vargo, S. L., Caswell, N., and Spohrer, J. 2009. "The Service System Is the Basis Abstraction of Service Science," *Information Systems and e-Business Management* (7:4), pp. 395-406.
Mayer, A. 2012. *App-Economy: Millardenmarkt Mobile Business*. München: mi-Wirtschaftsbuch.
Miles, M. B., Huberman, A. M., and Saldaña, J. 2014. *Qualitative Data Analysis: A Methods Sourcebook*. Los Angeles: SAGE Publications.
Müller, L., Mattke, J., Maier, C., and Weitzel, T. 2017. "The Curse of Mobile Marketing: A Mixed Methods Study on Individuals' Switch to Mobile Ad Blockers," *International Conference on Information Systems*, Seoul.
Nischak, F., Hanelt, A., and Kolbe, L. M. 2017. "Unraveling the Interaction of Information Systems and Ecosystems - a Comprehensive Classification of Literature," *International Conference on Information Systems*, Seoul.
North, D. C. 1990. *Institutions, Institutional Change and Economic Performance*. Cambridge University Press.
Nunes, A. A., Galvão, T., and e Cunha, J. F. 2014. "Urban Public Transport Service Co-Creation: Leveraging Passenger's Knowledge to Enhance Travel Experience," *Procedia - Social and Behavioral Sciences* (111:5), pp. 577-585.
Ordanini, A., Parasuraman, A., and Rubera, G. 2014. "When the Recipe Is More Important Than the Ingredients: A Qualitative Comparative Analysis (QCA) of Service Innovation Configurations," *Journal of Service Research* (17:2), pp. 134-149.
Park, Y., El Sawy, O. A., and Fiss, P. C. 2017. "The Role of Business Intelligence and Communication Technologies in Organizational Agility: A Configurational Approach," *Journal of the Association for Information Systems* (18:9), pp. 648-686.
Pollock, N., and Williams, R. 2006. "Technology Choice and Its Performance: Toward a Sociology of Software Package Procurement," *International Conference on Information Systems*, Milwaukee.
Puschmann, T., and Alt, R. 2016. "Sharing Economy," *Business & Information Systems Engineering* (58 1), pp. 93-99.
Ragin, C. C. 2008. *Redesigning Social Inquiry: Fuzzy Sets and Beyond*. Chicago: University of Chicago Press.
Reinhardt, W. 2012. *Öffentlicher Personennahverkehr: Technik - rechtliche und betriebswirtschaftliche Grundlagen*. Wiesbaden: Vieweg+Teubner Verlag.
Rihoux, B., and Ragin, C. C. 2009. *Configurational Comparative Methods: Qualitative Comparative Analysis (QCA) and Related Techniques*. Los Angeles: SAGE Publications.
Rivard, S., and Lapointe, L. 2012. "Information Technology Implementers' Responses to User Resistance: Nature and Effects," *MIS Quarterly* (36:3), pp. 897-920.
Schneider, C. Q., and Wagemann, C. 2007. *Qualitative Comparative Analysis (QCA) und Fuzzy Sets. Ein Lehrbuch für Anwender und jene, die es werden wollen*. Opladen: Barbara Budrich.

Schreieck, M., Kolbe, F., Pflügler, C., Wiesche, M., and Krcmar, H. 2018. "Monetarisierungsstrategien für Mobilitätsplattformen," in *Management digitaler Plattformen,* M. Wiesche, P. Sauer, J. Krimmling and H. Krcmar (eds.). Wiesbaden: Springer Gabler, pp. 67-91.

Schulz, T., Böhm, M., Gewald, H., Celik, Z., and Krcmar, H. 2020a. "The Negative Effects of Institutional Logic Multiplicity on Service Platforms in Intermodal Mobility Ecosystems," *Business & Information Systems Engineering*.

Schulz, T., Gewald, H., and Böhm, M. 2018. "The Long and Winding Road to Smart Integration of Door-to-Door Mobility Services: An Analysis of the Hindering Influence of Intra-Role Conflicts," *European Conference on Information Systems*, Portsmouth.

Schulz, T., Gewald, H., Böhm, M., and Krcmar, H. 2020b. "Smart Mobility: Contradictions in Value Co-Creation," *Information Systems Frontiers*.

Schulz, T., and Überle, M. 2018. "How Institutional Arrangements Impede Realization of Smart Ecosystems: The Case of Door-to-Door Mobility Integrators," *European Conference on Information Systems*, Portsmouth.

Scott, W. R. 2008. *Institutions and Organizations: Ideas and Interests*. Los Angeles: SAGE Publications.

Shaheen, S. A., Cohen, A. P., and Chung, M. S. 2009. "North American Carsharing: 10-Year Retrospective," *Transportation Research Record: Journal of the Transportation Research Board* (2110), pp. 35-44.

Shaheen, S. A., Guzman, S., and Zhang, H. 2010. "Bikesharing in Europe, the Americas, and Asia. Past, Present, and Future," *Transportation Research Record: Journal of the Transportation Research Board* (2143), pp. 159-167.

Sivunen, A., and Valo, M. 2006. "Team Leaders' Technology Choice in Virtual Teams," *IEEE Transactions on Professional Communication* (49:1), pp. 57-68.

Soto Setzke, D., Kavılı, M. C., and Böhm, M. 2020. "On the Use of Qualitative Comparative Analysis in Information Systems Research - A Critical Review," *European Conference on Information Systems*, Marrakesh.

Spohrer, J., Vargo, S. L., Caswell, N., and Maglio, P. P. 2008. "The Service System Is the Basic Abstraction of Service Science," *International Conference on System Sciences*, Hawaii.

Spohrer, J. C., and Maglio, P. P. 2010. "Toward a Science of Service Systems: Value and Symbols," in *Handbook of Service Science,* P. P. Maglio, C. A. Kieliszewski and J. C. Spohrer (eds.). Boston: Springer, pp. 157-194.

Storbacka, K., Brodie, R. J., Böhmann, T., Maglio, P. P., and Nenonen, S. 2016. "Actor Engagement as a Microfoundation for Value Co-Creation," *Journal of Business Research* (69:8), pp. 3008-3017.

Strauss, A. L., and Corbin, J. M. 1998. *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*. Thousand Oaks: SAGE Publications.

Su, N. 2013. "Internationalization Strategies of Chinese IT Service Suppliers," *MIS Quarterly* (37:1), pp. 175-200.

Teubner, T., and Flath, C. M. 2015. "The Economics of Multi-Hop Ride Sharing. Creating New Mobility Networks through IS," *Business & Information Systems Engineering* (57:5), pp. 311-324.

United Nations Department of Economic and Social Affairs. 2015. "World Urbanization Prospects".

Vargo, S. L., and Lusch, R. F. 2004. "Evolving to a New Dominant Logic for Marketing," *Journal of Marketing* (68:1), pp. 1-17.

Vargo, S. L., and Lusch, R. F. 2017. "Service-Dominant Logic 2025," *International Journal of Research in Marketing* (34:1), pp. 46-67.

Vargo, S. L., Maglio, P. P., and Akaka, M. A. 2008. "On Value and Value Co-Creation: A Service Systems and Service Logic Perspective," *European Management Journal* (26:3), pp. 145-152.

Verband Deutscher Verkehrsunternehmen. 2018. "2017 Statistik".

Watson, R. T., Boudreau, M.-C., Chen, A. J., and Sepúlveda, H. H. 2011. "Green Projects: An Information Drives Analysis of Four Cases," *Journal of Strategic Information Systems* (20:1), pp. 55-62.

Wikipedia. 2016. "Liste deutscher Tarif- und Verkehrsverbünde." Retrieved 2016-09-23, from https://de.wikipedia.org/wiki/Liste_deutscher_Tarif-_und_Verkehrsverb%C3%BCnde

Willing, C., Brandt, T., and Neumann, D. 2017a. "Electronic Mobility Market Platforms – a Review of the Current State and Applications of Business Analytics," *Electronic Markets* (27:3), pp. 267-282.

Willing, C., Brandt, T., and Neumann, D. 2017b. "Intermodal Mobility," *Business & Information Systems Engineering* (59:3), pp. 173-179.

Willing, C., Gust, G., Brandt, T., Schmidt, S., and Neumann, D. 2016. "Enhancing Municipal Analytics Capabilities to Enable Sustainable Urban Transportation," *European Conference on Information Systems*, Istanbul.

Yin, R. K. 2014. *Case Study Research: Design and Methods*. Thousand Oaks: SAGE Publications.
Zimmermann, S., Schulz, T., and Gewald, H. 2020. "Salient Attributes of Mobility Apps: What Does Really Matter for the Citizen?," *Pacific Asia Conference on Information Systems*, Dubai.

Appendix

Table 5 shows the truth table from our fsQCA. As recommended by Schneider and Wagemann (2007), we also conducted a fsQCA for the inverse outcome (choice of not state-of-the-art IT). The results are shown in Table 6 and 7.

No.	IRA	ADS	HCA	IMP	Choice of state-of-the-art IT	Raw consistency	PRI consistency	Cases
1	1	1	1	1	1	0.820	0.673	MD1; MD2; PM2; PM3
2	1	0	0	0	0	0.283	0.000	MD7; MD8/PM1
3	0	0	0	0	0	0.000	0.000	MD6/TP1
4	1	1	0	0	0	0.248	0.000	OM1
5	0	1	0	1	0	0.744	0.000	MD5
6	1	1	0	1	0	0.493	0.000	MD4
7	1	0	1	0	0	0.330	0.000	AR1/TP2
8	0	0	1	1	1	1.000	1.000	MD3

Table 5. Truth Table.

Attribute level	Consistency	Coverage	Attribute level	Consistency	Coverage
IRA	0.727	0.665	~IRA	0.408	0.749
ADS	0.589	0.648	~ADS	0.636	0.874
HCA	0.452	0.523	~HCA	0.729	0.942
IMP	0.408	0.427	~IMP	0.592	0.868

Table 6. Necessary Conditions for the Choice of not State-of-the-Art IT.

Sufficient sets	Raw coverage	Unique coverage	Consistency
~ADS*~HCA*~IMP	0.364	0.046	1
IRA*~ADS*~IMP	0.364	0.046	0.890
ADS*~HCA*IMP	0.228	0.136	1
IRA*~HCA*~IMP	0.409	0.045	0.901
IRA*ADS*~HCA	0.273	0	1
Solution coverage: 0.730			
Solution consistency: 0.890			

Table 7. Sufficient Conditions for the Choice of not State-of-the-Art IT.

Appendix H. Supplementary Material: Information Technology Choice in Mobility Service Ecosystems: A Qualitative Comparative Analysis (P6)

The following tables provide deeper insights into our fsQCA. Table 18 illustrates the attributes, which characterize the actors and the institutional arrangements of the TTA service ecosystems (causal sets), the set-membership measures for each attribute level, as well as exemplary quotations. Similarly, Table 19 depicts the attributes and their attribute levels for the choice of state-of-the-art IT (outcome set), the set-membership measures, and exemplary quotations.

Attribute	Set-membership measure	Description set-membership measure (= attribute level)	Exemplary quotations
Strong involvement of a regional authority (IRA)	1	Solely regional authorities	"The [name of the TTA] belongs to the districts and cities in the geographical area of the TTA." (PM2) "Association of 15 districts, 11 cities, […], and the [name of the federal state]." (PM3)
	0.67	Regional authorities as well as private and public transport companies	"The [name of the TTA] is an association of regional authorities and public transport companies." (MD1) "The [name of the TTA] is an association of bus companies […], as well as of the [name of the cities]." (OM1)
	0.33	Private and public transport companies, cooperation agreement with a regional authority	"All 21 public transport companies operating in the [name of the district] are shareholders of the TTA. The TTA is linked to the [name of the regional authority] by a cooperation agreement." (MD6)
	0	Transport companies that are sometimes in the hands of regional authorities	"The [name of the TTA] is the association of more than 20 bus, subway, tram, and train companies"; "[name of the public transport company] is a 100% subsidiary of the public utility." (MD3)
Advanced development stage of the TTA service ecosystem (ADS)	1	Differentiation stage	"We've been sitting together for months to prepare a test field for the autonomous bus ride." (MD1) "A test field for networked and autonomous driving in [name of the city]." (PM2)
	0.67	Maturity stage	"Since we were only founded six years ago, we had another focus in the first time. […] - to communicate the tariff, to further develop the tariff." (MD5) "That we want to change our tariff system. For example, we have no zone model." (OM1)

	0.33	Growth stage	"The [name of the tariff] will be replaced next year – and not only the [name of the tariff]. Five tariff areas receive a new common tariff." (MD3) "A new tariff will be introduced next year. […]. The different tariffs will be merged into a common [name of the geographical area] tariff." (MD7)
	0	Pioneer stage	"Our core tasks at the moment – in this initial phase of development – are, besides the tariff, customer information, as well as marketing and public relations." (MD6) "We have only been a TTA for two years and we are currently working on issues, such as the application of the tariff." (AR1)
High number of car-sharing actors (HCA)	1	Commonly available	Evaluation based on the bsc Bundesverband CarSharing e.V. (2015)
	0.67	Often available	
	0.33	Mostly not available	
	0	Unavailable	
Involvement of an alternative mobility provider (IMP)	1	Involvement	"The monthly fee is waived by the car-sharing as well as the bike-sharing company." (MD5) "If they have an annual ticket, the entry fee of the car-sharing company is waived." (PM2)
	0	Non-involvement	"Car-sharing and rental bike offers are not available at the moment." (MD6) "No. […]. But the integration of third parties – the last mile – that is exactly what is being discussed. How and whether this can be done." (AR1)

Table 18. Set-Membership Measures for Attributes, which Characterize the Actors and the Institutional Arrangements.

Attribute	Set-membership measure	Description set-membership measure (= attribute level)	Exemplary quotations
App (APP)	1	Available	“With the [name of the TTA]-app you have the timetable information everywhere.” (MD1) “We have a very well working [name of the TTA]-app.” (PM3)
	0	Unavailable	“That we want to offer an app. But there is no official decision yet.” (MD7) “Timetable and price information in the next year.” (OM1)
Equipment for real-time time-table data (RTD)	1	Commonly available	“We have established a TTA-wide data hub as a background system, which integrates the entire public transport into a real-time information.” (PM3)
	0.67	Often available	“Approximately 70% of public transport is covered.” (MD4) “We are currently setting up a system. Many companies can already deliver [real-time time-table data], but not all of them yet.” (AR1)
	0.33	Mostly not available	“Real-time time-table data […] are available. However, the provision is not so comprehensive that something could be achieved with it”. (OM1) “We have a data hub for real-time time-table data, which is currently under construction”; “the municipal transport company, [its name], and the regional tram company is already integrated.” (PM2)
	0	Unavailable	“At the moment, they [the real-time time-table data] are not available.” (TP1)
Mobile Ticketing (MT)	1	Available	“Now we have our own mobile ticketing.” (MD2) “We have a very well-functioning [name of the TTA] mobile ticketing system.” (PM3)
	0	Unavailable	“We currently do not have an electronic ticketing / mobile ticketing.” (MD4) “We don’t have yet a mobile ticketing, online ticketing, etc..” (MD8)
	1	Fully operational	-

Smart mobility platform (SMP)	0.67	Implementation	"We are on the home stretch in terms of multimodal information. […]. We are [also] working intently to ensure that customers receive one single mobility bill at the end of the month." (MD1) "Henceforth, a new map is shown […] to inform themselves about the available car-sharing vehicles and rental bikes as well as to book them"; "we would also like to integrate mobility services, such as […], ride-sharing, etc.." (PM3)
	0.33	Planning	"Planning is currently taking place to use mobility service-crossing information media (information platforms). First of all, to determine the need." (MD7) "We just ask ourselves what do we want to further integrate into our timetable information? Car-sharing, or bike-sharing, or so?" (AR1)
	0	No approach	"For us, this is an idea and a wish for the future, that we as [the name of the TTA] can offer our customers something like this and say: Here you find everything you need." (TP1)

Table 19. Set-Membership Measures for Attributes, which Characterize the Choice of State-of-the-Art IT.

Appendix I. Smart Mobility: Contradictions in Value Co-Creation (P7)

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Smart Mobility: Contradictions in Value Co-Creation

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Abstract
Technical progress is disrupting the mobility sector. New door-to-door (D2D) mobility integrators promise to offer smart mobility by packaging together different mobility services such as car-sharing and public transport. However, mobility providers up to now have rarely entered into value co-creation relationships. As a result, citizens are offered mobility that cannot be considered truly smart. Although value co-creation has been the subject of numerous studies taking the service-dominant logic perspective, this research has often lacked empirical evidence. To close this gap, we conceptualize value co-creation between mobility providers and a D2D mobility integrator by applying Activity Theory. Based on a qualitative study in the German mobility sector, we identify several inhibitors of value co-creation from the viewpoint of mobility providers. In addition, we show how these inhibitors serve as triggers for adaptations, ultimately leading to the formation of a value co-creation relationship.

Keywords Activity theory · Service-dominant logic · Smart mobility · Value co-creation

1 Introduction

Creating a new mobility paradigm is of one of the grand challenges of the twenty-first century. Cities around the world are confronted with urgent problems such as traffic congestion, parking problems as well as noise and air pollution (Willing et al. 2017a, 2017b; Benevolo et al. 2016; Gupta et al. 2019; Schreieck et al. 2018). One of the main reasons for this is the popularity of the use of private cars. For example, motorized private transport accounted for approximately 75% of the total transport volume in Germany in 2017 (Follmer and Gruschwitz 2019). The situation could deteriorate even further in the future through urbanization. One forecast predicts that the share of the worldwide population living in cities will increase from 50% in 2015 to 66% by 2050 (United Nations Department of Economic and Social Affairs 2015).

Despite its possible contribution to alleviating the problems, the share of mobility provided by public transport is often small. Inconveniences such as a lack of door-to-door (D2D) transport and poor information quality regarding transport services have been identified as key factors of non-usage (Beirão and Cabral 2007). In particular, the availability of the "right information at the right time" is considered to be important to facilitate sustainable behavioral changes in the broader public (Watson et al. 2011, p. 59). Several authors argue that information systems (IS) researchers can and need to contribute to the grand challenge of environmental sustainability (Watson et al. 2010; Elliot 2011; Hasan et al. 2017; Gupta et al. 2019; Akande et al. 2019; Gupta et al. 2018).

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The proliferation of information technology (IT) such as smartphones has simplified potential customers' access to information. Apart from the ever increasing availability of information, technical progress is increasingly changing the provision of services (Gretzel et al. 2015; Dai et al. 2018). Large amounts of data (big data) are generated and analyzed from a growing number of sources, such as smartphones, business transactions, sensors installed in vehicles (e.g., busses, cars, trains), and social media posts (Pappas et al. 2018). In this context, Mikalef et al. (2020) also denotes data "as one of the most valuable organizational resources".

The rise of big data and big data analytics lead to the emergence of new companies with new business models. Among other things, big data analytics is expected to result in new possibilities to satisfy customers' needs through better services, provide companies with an opportunity to develop a competitive advantage and increase business value, but also increase social value by contributing to the development of sustainable societies, for example, with regard to environmental sustainability (Pappas et al. 2018; Gupta et al. 2018; Mikalef et al. 2020; Klievink et al. 2017; Willing et al. 2017a; Popovič et al. 2018; Côrte-Real et al. 2020). However, to date, there is little research that focuses on the societal impact of big data and big data analytics (Pappas et al. 2018; Gupta et al. 2018).

Relying on big data and big data analytics, emerging D2D mobility integrators (like Moovel, Qixxit, etc.) strive to provide smart mobility from a defined starting-point to a defined end-point that is characterized by individual, context-aware, and dynamic bundling of mobility services such as bike-sharing, car-sharing and public transport (Schulz et al. 2018). Such smart mobility gives customers access to information about unexpected delays or cancellations, automatically updating their trip options accordingly. Since each of these mobility services is available individually on the market, this is a so-called 'component mobility service'.

The different mobility providers form a service ecosystem (Lusch and Nambisan 2015), and a D2D mobility integrator acting as keystone organization can be considered a 'smart integrator' (Schulz et al. 2018). The overall aim of the service ecosystem can be seen to improve world-wide quality of life by moving beyond addressing customer needs atomistically (Alt et al. 2019), and thus shifting human behavior towards non-private car-based mobility. According to Pappas et al. (2018), such service ecosystems that rely on vast amount of data of a number of actors can also be referred to as big data and business analytics ecosystems in which actors do not act in isolation. Hence, it is important to understand each of the actors, their data, and how they interact.

In order to offer customers smart mobility, mobility providers must provide various data about their mobility service, such as timetables, fares, passenger counts and vehicle positions (Ahlers et al. 2018). Unfortunately, to date, D2D mobility integrators in the German-speaking regions often struggle to get access to the data - specifically from public transport companies (Willing et al. 2017a, 2017b; Albrecht and Ehmke 2016). In addition, even if they get access, the quality of the data is often not good enough (e.g., only static timetables). These results are consistent with other studies (Klievink et al. 2017; Okwechime et al. 2018) that analyze the use of big data and big data analytics in different public organizations, and identify a need to catch up with private companies. Poor data quality makes it difficult to unlock the value of big data analytics (Côrte-Real et al. 2020). Thus, in order to be able to offer smart mobility, it is necessary to increase both the quantity and the quality of available data. But why are especially public transport companies not able or willing to co-create value?

The service-dominant (S-D) logic literature conceptualizes resource integration and service exchange as the building blocks of value co-creation (Vargo and Lusch 2017). From a mobility provider's point of view, the provision of a component mobility service that consists of a transport service and possibly supplementary services (e.g., the provision of real-time timetable information and of mobile tickets) on which we focus here, can generally be defined as "the application of resources for the benefit of others" (Vargo and Lusch 2017, p. 48). However, most studies adopting the S-D logic perspective are conceptual in nature and do not provide empirical evidence (e.g., Storbacka et al. 2016; Vargo and Lusch 2004, 2017). In addition, there are only few studies in the IS (e.g., Turetken et al. 2019; Schulz and Überle 2018; Gilsing et al. 2018; Hein et al. 2018; Schulz et al. 2020) and other scientific fields (e.g., Alexander and Jaakkola 2011; Echeverri and Skålén 2011; Gebauer et al. 2010; Pulkkinen et al. 2019; Yin et al. 2019) that have examined value co-creation in a mobility context. As Breidbach and Maglio (2016, p. 74) summarized: "we know very little about how economic actors engage in the process of value co-creation in traditional, co-located contexts […], let alone in technology-enabled ones".

To close this gap, Vargo and Lusch (2017, p. 46) recommend the use of theories outside of marketing to further develop the S-D logic perspective by creating "more midrange theoretical frameworks and concepts of service exchange, resource integration, [and] value cocreation". In response to this call, we draw on Activity Theory (AT) (Kuutti 1996; Engeström 1987) to examine the lack of value co-creation by analyzing the resource integration and service exchange actions that underlie the value co-creation activity of mobility providers (Vargo and Lusch 2017; Kuutti 1996). Building on the concept of contradictions (Engeström 1987), which become visible in form of double binds, critical conflicts, conflicts, and dilemmas (Engeström and Sannino 2011), and on the concept of congruencies (Allen et al. 2013), we identify the inhibitors to value co-creation and derive recommendations on how to solve them. Thus, we pose the research question: *How to increase value co-creation (i.e., resource integration and service exchange) by mobility providers to realize smart mobility?*

We conceptualize value co-creation from an interacting activity systems perspective. Based on this theoretical frame, we assess the inhibitors inherent in the activity systems. Our considerations are guided by the work of Schulz et al. (2020), who emphasize the benefits of adopting an activity system thinking for analyzing value co-creation, but without drawing on interacting activity systems as the unit of analysis (Engeström 2001) and the concepts of contradictions and congruencies (Allen et al. 2013; Engeström 1987).

We drew on interviews with experts from twelve German transport and tariff associations (TTAs), the regional representatives of public transport companies, to inform out conceptualization and test its applicability. One of the TTAs had recently signed a letter of intent with a D2D mobility integrator to join its service ecosystem. We find that in particular, the goal to provide smart local mobility in the future themselves, impedes the realization of value co-creation, and thus of smart mobility. Furthermore, our results show how these inhibitors serve as triggers for adaptations, ultimately leading to the formation of a value co-creation relationship.

The article is structured as follows. First, we present current developments in the fields of S-D logic perspective and AT. Then we outline our AT-based S-D logic perspective on value co-creation. Next, we elucidate the context of our study and our methodology. Finally, we present our results and discuss the implications of our study and its limitations and avenues for future research. The article closes with a conclusion.

2 Theoretical Foundation

2.1 Service-Dominant Logic Perspective

The cooperation of several actors for service provision can be analyzed by adopting the service-dominant (S-D) logic perspective. The S-D logic perspective was originally introduced to marketing (Vargo and Lusch 2004), but in the meantime is established in numerous scientific fields, including business economics (e.g., Koskela-Huotari et al. 2016; Storbacka et al. 2016) and IS (e.g., Hein et al. 2019; Giesbrecht et al. 2017; Winkler and Wulf 2019; Rahman et al. 2019; see Brust et al. 2017 for an overview). Some of the studies focused on value co-creation in a digital (e.g., Turetken et al. 2019; Schulz and Überle 2018; Gilsing et al. 2018; Hein et al. 2018; Pulkkinen et al. 2019; Schulz et al. 2020) and a non-digital (e.g., Alexander and Jaakkola 2011; Echeverri and Skålén 2011; Gebauer et al. 2010) mobility context.

The intended change in focus among citizens away from the purchase of private cars towards the use of mobility services represents a shift from the goods-dominant (G-D) logic to the S-D logic (Schulz and Überle 2018). This change can be supported by technological progress, which has fostered the emergence of IT-based service ecosystems, such as in the case of ride- and car-sharing. The S-D logic perspective is based on three concepts: (1) the service ecosystem, (2) the service platform, and (3) value co-creation (Hein et al. 2018; Lusch and Nambisan 2015).

A **service ecosystem** is an actor-to-actor network and can be defined as "a relatively self-contained, self-adjusting system of mostly loosely coupled social and economic (resource-integrating) actors connected by shared institutional logics and mutual value creation through service exchange" (Lusch and Nambisan 2015, p. 161). Schulz and Überle (2018) specified the actors involved in the service ecosystem of a D2D mobility integrator. The actors include different mobility providers, such as public transport, car-, bike-, and ride-sharing companies, government agencies (national government, municipalities, etc.) and customers. The shared institutional logics (or synonymously the institutional arrangements) (Vargo and Lusch 2017; Lusch and Nambisan 2015), which represent rules, norms, and beliefs, govern the actors and their service exchange within and between service ecosystems (Vargo and Lusch 2017). However, institutional arrangements not only enable service exchange, they can also constrain it (Schulz et al. 2020). In this vein, Koskela-Huotari et al. (2016, p. 2964) highlighted that "breaking, making, and maintaining" institutional arrangements creates opportunities for a new form of value co-creation.

A **service platform** represents "a modular structure that consists of tangible and intangible components (resources) and facilitates the interaction of actors and resources (or resource bundles)" (Lusch and Nambisan 2015, p. 162). By using a service platform, actors can make their service exchange more effective and efficient (Lusch and Nambisan 2015; Hein et al. 2018). In the present case, the smartphone app provided by a D2D mobility integrator serves as a service platform. The smartphone app recommends different bundles of mobility services, including automatic adjustments in case of delays and cancellations, for a door-to-door trip. This allows customers to reduce their search costs and cognitive effort in the run-up, as well as during the trip.

Technological breakthroughs (like the availability of sensors and smartphones) and changes that occur in an industry logic, as it is currently the case in the mobility sector, offer new opportunities for value co-creation (Payne et al. 2008). **Value co-creation** is defined as resource integration and service exchange by the actors of a service ecosystem (Vargo and Lusch 2017). Customers are also involved in value co-creation (Vargo et al. 2008). For example, they can use the smartphone app to provide information on how crowded the bus or train is at the moment (Nunes et al. 2014). While the G-D logic is based on the assumption that the value of goods, such as cars, is determined by the producers (value-in-exchange), one of the central assumptions of S-D logic is its principle of value-in-use (Vargo and Lusch 2004), or more specifically value-in-context (Vargo and Lusch 2017; Vargo et al. 2008), which means "that value is fundamentally derived and determined in *use* – the integration and application of resources [i.e. service (Vargo and Lusch 2017)] in a specific context – rather than in *exchange* – embedded in firm output and captured by price" (Vargo et al. 2008, p. 145).

The value that an individual actor of a service ecosystem can realize through value co-creation can be very different. For a non-digital context, Alexander and Jaakkola (2011) have defined the value that arises for customers as improved station environments and reduction in anti-social behavior. In contrast, the value generated for companies, for instance, is an increase in passenger volume and a differentiation from competitive offers (Gebauer et al. 2010). For a digital context, Gilsing et al. (2018, p. 2) explained that customers "look at the value (e.g., the flexibility and ease-of-use) offered by car sharing applications". In the case of the smartphone apps provided by the D2D mobility integrators, the value for customers could be economic in nature, if the bundle of mobility services with the cheapest price is recommended, or social, if the bundle with the least air pollution is identified. For the mobility providers, such as public transport companies, value is generated in form of higher customer satisfaction by offering door-to-door mobility and higher customer loyalty for example.

Notwithstanding the fact that the S-D logic perspective is established in many scientific fields and is accepted for the analysis of value co-creation in service ecosystems, there are some limitations that make its application and especially the generation of practical implications difficult. Currently, the S-D logic perspective is on a meta-theoretical level (Vargo and Lusch 2017), which means that value co-creation is difficult to observe empirically. As a result, there are numerous conceptual studies, on the basis of which it is difficult to derive practical implications. A remedy can be provided by the use of actor engagement as microfoundation for value co-creation, which is defined as "both the actor's disposition to engage, and the activity of engaging in an interactive process of resource integration within a service ecosystem" (Storbacka et al. 2016, p. 3008).

To further develop the S-D logic perspective, Vargo and Lusch (2017, p. 46) recommended the development of "more midrange theoretical frameworks and concepts of service exchange, resource integration, value cocreation, value determination, and institutions/ecosystems. These midrange theories can be partially informed by theories outside of marketing". Corresponding future studies should focus in particular on IT-enabled value co-creation, since knowledge about it is very limited (Breidbach and Maglio 2016).

In the following section, we introduce AT, which can help in further development of the S-D logic perspective. Three specific characteristics of AT make it advantageous for complementation: (1) AT assumes that several actors are involved in an activity. This assumption fits the concept of service ecosystem stemming from the S-D logic perspective; (2) the activity system, which constitutes the basic unit of analysis of AT, includes the instruments element. Thus, IT, such as a service platform (i.e. a smartphone app) that is used in a service ecosystem, can be taken into account; and (3) the three levels of an activity (activity, actions and operations) allow the use of actor engagement as a microfoundation for value co-creation.

2.2 Activity Theory

Activity Theory (AT) is a "philosophical and cross-disciplinary framework for studying different forms of human practices" (Kuutti 1996, p. 25). Scholars in numerous research fields, such as IS (Hasan et al. 2017; Allen et al. 2013; Karanasios and Allen 2013, 2014; Sun 2020; Slavova and Karanasios 2018; Malaurent and Karanasios 2020; Dennehy and Conboy 2020; Schulz et al. 2020, etc.), management sciences (e.g., Jarzabkowski 2003), organizational sciences (e.g., Engeström 2000a; Blackler et al. 2000), education (Engeström 2001; Dionne and Bourdon 2018, etc.) and research on human-computer interaction (Kuutti 1996; Kaptelinin 1996, etc.) view AT as an important theory that can lead to novel theoretical and practical contributions. AT has already been used to investigate and redesign work activities of individuals and teams (Engeström 2000b). Numerous scholars (Karlsson and Wistrand 2006; Korpela et al. 2004; Zott and Amit 2009) have argued that entire companies can also be viewed as activity systems. Expanding the activity system thinking beyond a company's boundaries can enrich the S-D logic perspective (Schulz et al. 2020).

The basic assumption of AT is that the activity of a subject (a person or a collective) is always directed towards a tangible or intangible object in order to transform it and to subsequently achieve a specific outcome (Engeström 1987; Leont'ev 1978). In other words, the object is "the 'raw material' or 'problem space'" (Engeström 1993, p. 67). An activity is a longer-term formation and "consist[s] of *actions* or chains of actions, which in turn consist of *operations*" (Kuutti 1996, p. 30). An activity is based on an overall motive (in our case the realization of value co-creation), while conscious actions are goal-oriented. Actions, in turn, consist of several non-conscious operations that represent well-defined routines. The borders between these hierarchical levels of an activity are blurred and movements are possible (Kuutti 1996). For example, "an activity can lose its motive and become an action, and an action can become an operation when the goals changes" (Davydov et al. 1983, p. 36). Due to this circumstance, it is not possible to provide a general classification of what an activity (or action or operation) is (Kuutti 1996).

In line with the S-D logic perspective (Vargo and Lusch 2017), the value co-creation of each actor can be understood as an activity consisting of two successive actions: resource integration and service exchange. In the case of a public transport company (i.e. subject), the two actions are carried out with the goal of transporting customers between stations (i.e. object). In contrast, the goal of a D2D mobility integrator is the provision of smart mobility. Based on the assumption that actor engagement is a microfoundation of value co-creation, "both the actor's [for instance, the public transport company's] disposition to engage, and the activity of engaging" (Storbacka et al. 2016, p. 3008) in the two actions are in the focus of interest.

Human activities are always mediated by one or more tangible and intangible instruments (in our case a ticketing machine, vehicle, etc.) (Engeström 1987; Leont'ev 1978; Vygotsky 1978) that enable the subject to transform the object and to obtain a specific outcome more efficiently (Blackler et al. 2000; Allen et al. 2013). Hence, instruments are artefacts that empower a subject through the experiences and skills collected over time. Nevertheless, an instrument can also limit the possible actions of a subject (Kuutti 1996). The relationship between subject, object, and instrument – also denoted as first generation of AT (Engeström 2001) – is illustrated in the form of a triangle and constitutes the first part of the activity system (Fig. 1).

Engeström (1987) extended the basic triangle by adding the community to the activity system, which also mediates the relationship between the subject and the object. In addition, the rules and the division of labor are added, creating further mediating relationships (second generation of AT). The rules cover explicit and implicit norms, conventions, and social relations (e.g. transport guidelines, pricing schemes). The explicit and implicit organization within a collective activity is captured by the division of labor (Kuutti 1996).

Last but not least, the third generation of AT focuses on the analysis of two or more interacting activity systems. Figure 1 shows how "the object moves from an initial state of unreflected, situationally given 'raw material' (object 1; […]) to a collectively meaningful object constructed by the activity system (object 2, […]), and to a potentially shared or jointly constructed object (object 3; […])" (Engeström 2001, p. 136) for the minimal case of two interacting activity systems. The third generation of AT can be summarized by five principles, which are shown in Table 1.

Since the principle 4 is particularly important for the theoretical foundation of the present study, some further explanations on contradictions are provided. Contradictions oppose "the overall motive of the system, the aim or purpose that subjects within the system are individually or collectively striving toward" (Allen et al. 2013, p. 840), but cannot be observed directly; they only manifest themselves as double binds, critical conflicts, conflicts, and dilemmas (Engeström and Sannino 2011).

Engeström (1987) distinguished four levels of contradictions, which are located on different positions of the activity system (see Fig. 1): (1) Primary contradictions can arise *within* each element of the activity system. An example is the lacking interoperability of IT systems in the case of the instruments element. (2) Secondary contradictions exist *between* the elements of the activity system. For instance, strong cost pressure (i.e. rules) may cause that advanced IT, such as a mobile ticketing solution and sensors that are necessary for the provision of real-time timetable information, are not integrated into the activity system of a public transport company. (3) Tertiary contradictions are located *between* the object of an activity and the object of a culturally more advanced form of the same activity. Instead of offering a transport service that is based on a fixed timetable, a public transport company can, for instance, provide transport on demand. This type of contradiction is not relevant to the current study. (4) Quaternary contradictions occur *between* interacting activity systems. For example, such a contradiction occurs between the two objects when the component mobility service provided by a public transport company, for example due to the lacking integration of real-time timetable information, prevents the provision of smart mobility by a D2D mobility integrator.

Through a process of feedback and action, contradictions can be transformed into congruencies, which reflect the

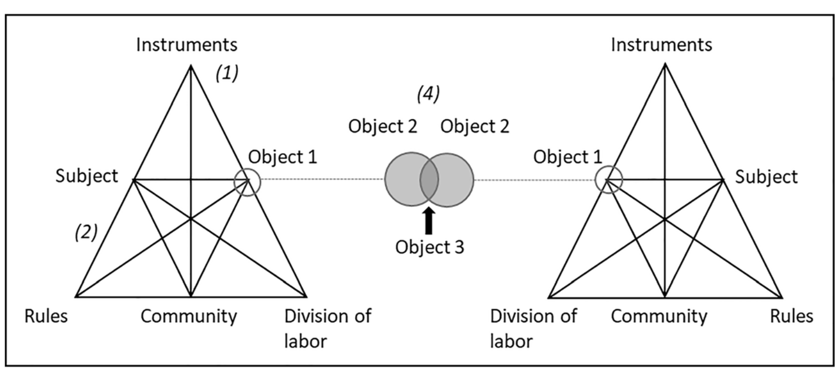


Fig. 1 Two Interacting Activity Systems as Minimal Model for the Third Generation of AT (based on Engeström 2001, p. 136 and Engeström 1987)

"stabilizing forces within activity systems" (Allen et al. 2013, p. 841). A congruence between the elements of an activity system arises when, for example, contradictions trigger the introduction of new IT, which in contrast to the old IT, fits the established rules and division of labor. In other words, congruencies influence the decision whether, and in what way, the actors of an activity system adopt IT (Allen et al. 2013).

Due to the concepts of contradictions and of congruencies, we believe that AT can constructively complement the S-D logic perspective. According to the latter, "breaking, making, and maintaining the institutionalized rules of resource integration" established in a service ecosystem offers actors the opportunity to realize a novel form of value co-creation (Koskela-Huotari et al. 2016, p. 2964). AT focusing on interacting activity systems and on the transformation of contradictions into congruencies can provide a deeper theoretical foundation.

3 Value Co-Creation in Cross-Company Activity Systems

AT offers a useful theoretical lens through which the lack of value co-creation (defined as activity) of mobility providers can be analyzed in the context of D2D mobility integrators. First, we can further specify the elements of the interacting activity systems (i.e. subject, object, instruments, rules, community, and division of labor) (Engeström 2001), which must be taken into account in the analysis of value co-creation. Second, AT explicitly conceptualizes IT as a mediating instrument within an activity (Kuutti 1996) and thus makes it possible to focus on IT-enabled value co-creation. Finally, a deeper understanding of AT – in contrast to Schulz et al. (2020) – to include an application of both its concepts of contradictions (Engeström 1987) and congruencies (Allen et al. 2013) might help us identify solutions to inhibitors (which are the manifestations of contradictions) for value co-creation.

Table 1 The Principles of the Third Generation of AT (Engeström 2001, p. 136)

Principle	Explanation
1. Activity system as the prime unit of analysis	"A collective, artefact-mediated and object-oriented activity system, seen in its network relations to other activity systems, is taken as the prime unit of analysis. Goal-directed individual and group actions, as well as automatic operations, are relatively independent but subordinate units of analysis".
2. Multi-voicedness of an activity system	"An activity system is always a community of multiple points of view, traditions and interests. The division of labor in an activity creates different positions for the participants, the participants carry their own diverse histories, and the activity system itself carries multiple layers and strands of history engraved in its artifacts, rules and conventions. The multi-voicedness is multiplied in networks of interacting activity systems. It is a source of trouble and a source of innovation".
3. Historicity of an activity system	"Activity systems take shape and get transformed over lengthy periods of time. Their problems and potentials can only be understood against their own history. History itself needs to be studied as local history of the activity and its objects, and as history of the theoretical ideas and tools that have shaped the activity".
4. Central role of contradictions as sources of change and development	"Contradictions are historically accumulating structural tensions within and between activity systems. […]. When an activity system adopts a new element from the outside (for example, a new technology or a new object), it often leads to an aggravated secondary contradiction where some old element (for example, the rules or the division of labor) collides with the new one. Such contradictions generate disturbances and conflicts, but also innovative attempts to change the activity".
5. Possibility of expansive transformations	"Activity systems move through relatively long cycles of qualitative transformations. As the contradictions of an activity system are aggravated, some individual participants begin to question and deviate from its established norms. In some cases, this escalates into collaborative envisioning and a deliberate collective change effort. An expansive transformation is accomplished when the object and motive of the activity are reconceptualized to embrace a radically wider horizon of possibilities than in the previous mode of the activity".

In the following, we discuss our AT-based S-D logic perspective on value co-creation. In order to enable a more general theory development, we adopt a broad perspective and do not limit ourselves to the mobility sector. We use the term *service provider* to describe a company that is offering an independent and freely available service on the market (i.e. a component service). On the other hand, a *smart integrator* and the service providers from its service ecosystem provide component service packages so that the customer receives a holistic solution.

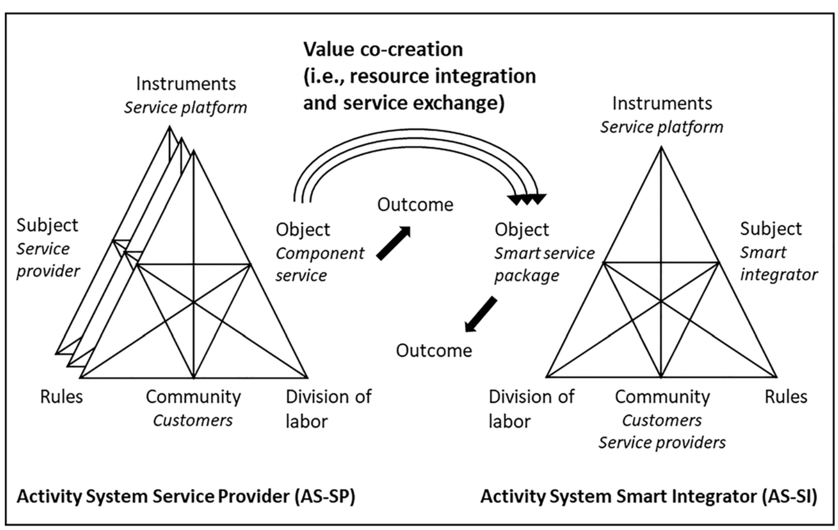
We first describe the activity system of a service provider (AS-SP) as illustrated in Fig. 2 on the left. In this case, the value co-creation activity of a service provider (i.e. subject) is directed to the provision of a specific service like a financial advisory, an education service, or a healthcare service (i.e. object) to satisfy a customer need. A number of different mediating instruments, some of which represent a service platform in terms of the S-D logic perspective (Lusch and Nambisan 2015), can be deployed during this activity. For example, a bank can introduce tablets to improve the face-to-face advisory process (Nueesch et al. 2014) or a customer (i.e. community) can use a video that is provided in an electronic learning system (Zhang et al. 2006). In addition, there are rules such as medical confidentiality (Kottow 1986) that govern the relationship between the service provider and the customer. Due to the fact that a customer in addition to the service provider performs a value co-creation activity (Vargo and Lusch 2004), a division of labor also exists. For example, it is necessary that the customer provides her/his requirements (e.g. timeline) at the beginning of a service (Nueesch et al. 2014).

A complex customer need can however not be satisfied by a single service provider (Alt et al. 2019). In the traditional case, due to a service provider's focus on its component service, customer support for the creation of a service package is not possible. According to Alt et al. (2019), this applies in particular to the aforementioned sectors. A customer therefore has to combine a number of component services manually to receive a holistic solution (i.e. outcome). Figure 2 depicts the component services provided by three exemplary service providers as object of three staggered activity system triangles.

The activity system of a smart integrator (AS-SI) is illustrated in Fig. 2 on the right. We focus on its value co-creation activity, which includes, among others, a customer and service providers (i.e. community). The activity is directed towards the transformation of different component services in a smart service package (i.e. object) to better satisfy an existing need (i.e. outcome). Thus, the object of each AS-SP transforms into the object of AS-SI. The more or less standardized component services (e.g. public transport, car-sharing service) of individual service providers are now no longer of immediate concern. Instead, we concentrate on the realization of a smart service package. For this, a customer must take a more active role in the service process. For example, s/he must continuously integrate information about her/his changing context (i.e. division of labor). In addition, a smart integrator relies on advanced IT such as an algorithm for the automatic packaging of component services (i.e. instrument) to offer a smart service package. A particular characteristic of a smart service package is its strong dependence on component services. For instance, the total price as well as its overall quality depend on all of the component services. Correspondingly, there is a need for rules governing the often diverging motives and interests of the service ecosystem actors.

Regardless of the advantages such as lower search costs (i.e. outcome) that smart integrators promise the customers, contemporary smart integrators often struggle to provide smart service packages (Alt et al. 2019). We assume that this is partly caused by insufficient *resource integration* by service providers. For instance, such as when there is currently no appropriate service description by service providers that allows a technically automated comparison and bundling of

Fig. 2 AT-based S-D Logic Perspective on Value Co-Creation



component services (Winter et al. 2012). Drawing on AT, insufficient resource integration actions by service providers indicate contradictions in their higher-level value co-creation activity. In the following, we illustrate exemplary inhibitors (manifestations of contradictions) identified in scientific literature and locate them within the AS-SPs.

According to Schmidt-Rauch and Nussbaumer (2011), two of the most important inhibitors for value co-creation in the case of financial advisory are the so-called dialog problem and the diverging-goals problem. In order to provide a high-quality service, an extensive dialogue between the customer and the service provider is necessary. In this dialogue, the customer problem must be revealed through needs assessment and be compared with available solutions. However, when both actors speak different languages, for instance if the service provider uses technical terminology and the customer speaks a natural language, a constructive exchange is difficult and therefore appropriate resource integration actions of a service provider are impeded. Adopting an activity system view, this language example indicates a contradiction within the rules element of an AS-SP.

In contrast, the diverging-goals problem reveals a contradiction between two activity system elements. It refers to the circumstance that the business model and strategies (i.e. instruments) of a service provider are often in conflict with the customer's expectation of symmetric conversation (i.e. rule). For instance, a customer may have the goal of identifying the financial service that best fits her/his needs through an extensive interaction, while the service provider's business model is based on a self-service approach. There are also a number of studies that focus on other sectors (e.g., Minkiewicz et al. 2016; Hildebrandt et al. 2018). For example, based on their analysis of knowledge intensive business services, Aarikka-Stenroos and Jaakkola (2012) show that there is a risk of inferior service being provided because a collaborative problem solving process (a form of division of labor) is impeded by the belief of service providers (i.e. rules) that customers can not contribute to a successful service provision.

In the case of the service ecosystem of D2D mobility integrators, Albrecht and Ehmke (2016) and Willing et al. (2017a, 2017b) show that not only are there insufficient resource integration actions among service providers, but that most service providers do not conduct *service exchange* actions. Drawing on our AT-based S-D logic perspective on value co-creation, such a situation is characterized by contradictions located within and between the elements of an AS-SI. A possible inhibitor to service exchange, which is located in the rules element, is described by de Reuver et al. (2009), stating that both service providers and intermediaries, such as a smart integrator, will often be interested in billing the customer.

In summary, drawing on AT, we conceptualize value co-creation by service providers as an activity consisting of two actions – resource integration and service exchange (Vargo and Lusch 2017). Taking the observed limited capabilities of D2D mobility integrators in account to provide smart mobility (Willing et al. 2017a, 2017b; Albrecht and Ehmke 2016), we assume the existence of contradictions in the (potentially) interacting activity systems of mobility providers and a D2D mobility integrator. With an ongoing adaptation process, the service ecosystem actors can try to create a congruence between the elements of the activity systems (Allen et al. 2013), in other words, to eliminate the contradictions in order to put value co-creation into practice.

4 Research Context and Methodology

4.1 Research Context

In 2017, more than 10 billion rides were conducted with German public transport companies (Verband Deutscher Verkehrsunternehmen 2018). Public transport in Germany is predominantly organized by transport and tariff associations (TTAs). While TTAs have represented cooperation of independent public transport companies (bus, subway, local train and/or tram) in the past, regional authorities, such as federal states, districts, or cities today increasingly act as (additional) shareholders (Reinhardt 2012). Due to this organizational structure, the decision of a TTA not to engage in value co-creation with a D2D mobility integrator leads to a large local blank spot on the map where none of the mentioned public transport services is available for packaging into smart mobility solutions. Another reason for choosing German TTAs as representatives of mobility providers is that they should be sufficiently familiar with D2D mobility integrators to answer our questions, since the smart mobility concept is most advanced in Europe, in particular in Germany (Willing et al. 2017b).

4.2 Methodology

In 2016, there were approximately 124 active TTAs in Germany (Reinhardt 2012; Wikipedia 2016). Using a theoretical sampling method (Flick 2009), we selected 45 TTAs that have not established a value co-creation relationship with a D2D mobility integrator. The selected TTAs vary in terms of the number of public transport companies they represent and the passengers per year. We approached the managing director (MD) of each TTA as primary contact person since s/he is responsible for strategic decisions such as cooperation with a D2D mobility integrator. Adopting a snowball sampling method (e.g., Su 2013), we encouraged interviewees to nominate additional or more appropriate experts for interviews. This data collection approach of "using numerous and highly knowledgeable informants" (Eisenhardt and Graebner 2007, p. 28) helps us to mitigate potential bias. We received interview confirmations from twelve TTAs. Table 2 presents the interviewees' demographic data and information about their TTA.

We developed a semi-structured interview guideline containing questions about the TTA's activity system and the possible interacted activity system of a D2D mobility integrator. Semi-structured interviews offer high flexibility because they allow open-ended questions and responses to interesting topics that arise spontaneously during the interview (Flick 2009). The questions focused on the different elements of the activity systems, especially on the IT adopted as well as on possible inhibitors. For instance, we asked the interviewees whether the TTA has a mobile ticketing solution or not. If the TTA has no mobile ticketing solution, we tried to find out the inhibitors by asking questions, for example, about the rules established among the members. As recommended by Flick (2009) and Miles et al. (2014), we followed a data triangulation strategy and collected secondary data such as association reports and press releases. We relied on and referred to these secondary data during the interviews to validate the statements of the interviewees. The interviews were conducted in the last quarter of 2016 and lasted between 40 and 75 min each (average 66 min).

All interviews were recorded and transcribed. The data was analyzed using the NVivo 10 software program. Data analysis encompassed two cycles and followed an iterative coding approach. In a first cycle, one of the researchers scanned, categorized, and coded the data parallel to data collection. The initial coding scheme built on the interacting activity systems as basic units of analysis in AT (see Fig. 2). Based on the data material, these coding categories were refined. 'Mobile ticketing solution' and 'equipment for the provision of real-time timetable data' are, for example, two of the sub-categories of the 'instruments' category. In a second cycle, the codes for each interview were related to each other (Miles et al. 2014), and the sub-categories were, if necessary, redefined and subdivided.

The authors frequently discussed the emerging coding during the entire coding process to address coding bias and to enhance internal validity of the results. The comparison and common interpretation of coded data followed the guidelines proposed by Miles et al. (2014). Data collection was suspended when data saturation was reached, i.e. when incremental learning about the interacted activity systems and the involved inhibitors for value co-creation were minimal (Yin 2014).

5 Results

5.1 Inhibitors for Resource Integration

We structured our results using our AT-based S-D logic perspective on value co-creation as depicted in Fig. 2. Considering our mobility context, we defined both types of activity systems as AS-MPs in the case of mobility providers and as an AS-MI in the case of a D2D mobility integrator. Based on the AS-MPs, we can analyze the insufficient resource integration actions by TTAs, or more specifically, one of their public transport companies. We focus on the

Table 2 Overview of Interviewees and Represented TTAs

ID	Role / Function	Gender	Years in position	Number of public transport companies	Passengers per year (in millions) a)
MD1	Managing director	Male	5	≥ 40	≤ 400
MD2	Managing director	Male	4	≤ 10	≤ 300
MD3	Managing director	Female	6	≤ 30	≤ 200
MD4	Managing director	Female	11	≤ 20	≤ 50
MD5	Managing director	Male	6	≤ 10	≤ 50
MD6 TP1	Managing director Transport planning	Male Male	2 1	≤ 30	≤ 50
MD7	Deputy managing director	Male	12	≤ 10	n.a.
MD8 PM1	Deputy managing director Project manager	Male Male	6 1	≤ 20	≤ 50
AR1 TP2	Authorized representative Transport planning	Female Female	6 2	≥ 40	≤ 300
PM2	Project manager b)	Male	2	≤ 20	≤ 200
PM3	Project manager	Male	6	≤ 30	≥ 700
OM1	Office manager	Male	1	≤ 20	≤ 50

a) Latest available figures

b) The interviewee disclosed that the TTA had recently signed a letter of intent with a D2D mobility integrator. This cooperation has also been made public in the meantime.

lacking integration of mobile tickets and of real-time timetable information in the mobility service offered to their customers. In addition, a D2D mobility integrator needs a component mobility service in which the two resources are integrated to provide one-stop ticketing and to enable adjustments of the service packages in case of delays or cancellations.

In a first step, we have further specified the elements of the AS-MPs based on the interviews. The overall goal of a public transport company (i.e. subject) is to provide a component mobility service that consists of a transport service and possibly supplementary services (i.e. object) to satisfy customers' mobility needs (i.e. outcome). In the course of the service, the public transport company and its customers use different instruments such as a ticketing machine and a vehicle to obtain the outcome more efficiently. The provision of the component mobility service is also mediated by the customers and the other members of the TTA, such as regional authorities (i.e. community), as well as by the rules and the division of labor. Such rules may include a tariff system, a commission agreement for ticket sales (e.g. MD1, MD5, OM1) and route tenders (e.g. AR1, MD1). The division of labor, among other things, specifies which public transport companies of a TTA are allowed to sell tickets (e.g. MD4, MD5).

Technical progress (e.g., sensors and open data) and the proliferation of mobile devices have the potential to change the provision of the component mobility service accompanied by a change in the instruments element of the AS-MPs. However, as the following results illustrate, German TTAs and their public transport companies often struggle to integrate **mobile tickets** into their component mobility service.

A first inhibitor for their integration of mobile tickets, and thus for their value co-creation, is located in the upper triangle of the AS-MPs as illustrated in Fig. 3. Public transport is a public good, to which specific explicit and implicit norms are attached. For example, in contrast to private goods, public goods can usually not be offered at cost-covering prices, which makes it necessary to subsidize them with tax money. Many interviewees highlighted that mobile tickets are a *"requirement that a customer wants to have at some point"* (MD4; see also e.g. MD2, OM1). However, the integration of mobile tickets reflects a supplementary service without *"additional revenue"* (MD4).

On the other hand, relatively high costs are associated with the introduction of a mobile ticketing solution, resulting in poor cost efficiency. One reason for this is that a mobile ticketing solution *"is a permanent cost factor"* because it is a *"system where I always have to adapt to new mobile device generations"* (MD4). In addition, the mobile provider charges a high commission (MD6). As a result, a public transport company *"still ends up with less money than it receives from other distribution channels"* (MD5). As this quotation shows, the interviewees compared the cost efficiency of different instruments (e.g., ticketing machines and mobile ticketing solution) that can be used for ticket sales. The cost efficiency of mobile ticketing cannot be improved by the termination of another instrument for ticket sale. The reason for this is the explicit norm that public transport should be available to all people, i.e. also to the elderly who do not use a smartphone, for example.

A second inhibitor for the integration of mobile tickets is the division of labor that is historically established in the AS-MPs. Currently, due to the explicit organization that is engraved in the earnings allocation contracts, there are few incentives for a public transport company to implement mobile ticketing or to adopt the solution of its TTA. According to the earnings allocation contracts, each public transport company is obliged to report its earnings for each ticket sale instrument, such as mobile ticketing, online store and ticketing machines. Based on this, the TTA calculates the total amount and uses complex *"mathematical methods with corresponding projections, […] to determine the share of the total amount owed to the public transport company A, B, C, or D"* (MD3, see also MD2, MD5, MD7). This allocation is made based on a variety of information (MD3), for example passenger kilometers or tariff zones. In other words, there is a high division of labor, including a separation between the provision of the transport service and the sale of single ticket types. As a result, a public transport company may refrain from selling mobile tickets. The situation is aggravated if the division of labor is not accompanied by a commission agreement for ticket sales – *"we are rural, we are small, in some things we are not up-to-date. At the moment, no commissions are paid in our TTA"* (MD4).

Lastly, there is an inhibitor located within the instruments element of the AS-MPs that prevents the integration of mobile tickets in the component mobility service. In the case of AR1 (see also OM1), the existing *"IT is not capable of supporting"* a mobile ticketing solution because it cannot cover the highly complex tariff system. Most of the major TTAs or the associated large public transport companies possess a mobile ticketing solution that they operate themselves or that is operated by an external mobile ticketing provider (MD1, MD3, MD5, PM3). However, this does not mean that all ticket types are available through mobile devices. For instance, MD2 explained that only single tickets are currently offered.

As already mentioned above, the public transport is a public good. Regional authorities (i.e. community) are pursuing the goal of providing affordable mobility for all people (e.g., elderly, rural dwellers) to meet their need for social and economic participation. In order to achieve this goal, the TTAs are increasingly introducing tenders that represent explicit norms by which they govern the provision of component mobility services by public transport companies. Through these tenders, the TTAs can specify the transport service, for example, by determining how often a particular route is operated. But the supplementary services that are based on the

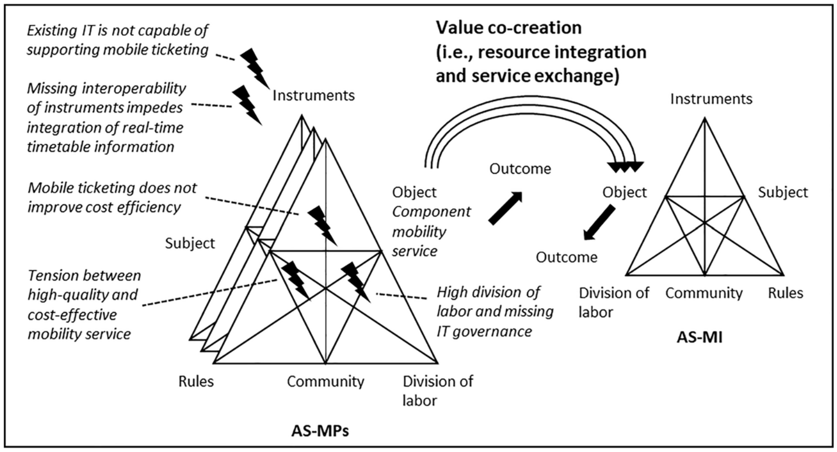


Fig. 3 Inhibitors for the Integration of Mobile Tickets and of Real-Time Timetable Information

integration of resources, such as **real-time timetable information**, can also be defined via the tenders.

In this vein, a first inhibitor exists for the integration of real-time timetable information in the relationship between subject and object mediated by the rules if no tenders have been introduced. In such a situation, *"cherry picking by public transport companies"* (MD4, see also MD7) often develops, which means that desired but economically unattractive route sections are not offered and investments that are necessary for the provision of supplementary services, such as in equipment for the generation of real-time timetable information, are rejected. Explicit norms that result from tenders conducted in the past also have a negative impact on the integration of real-time timetable information. Due to long contract durations, *"not all route bundles are tendered in such a way that real-time data provision is prescribed"* (PM2).

In addition, there are two different types of tenders that reflect the goals of TTAs to provide a high-quality and/or a cost-effective component mobility service to different degrees. Gross tendering (e.g. MD3, MD7) means that a public transport company receives a fixed price for the provision of the component mobility service, while the passenger income remains with the carrier (i.e. TTA and its regional authorities). As a result, a public transport company has an interest in minimizing its costs, i.e. it will only integrate real-time timetable information if specified in the tender. In net tendering (e.g. MD1) in comparison, a public transport company obtains passenger income as well as possibly additional grants – *"in the case of public train transport, I know of no situation nationwide where public transport companies operate without extra grants"* (MD7). In this case, the public transport company will evaluate whether the integration of real-time timetable information can attract new customers and if the additional revenues will compensate for the costs incurred.

A second inhibitor for the integration of real-time timetable information exists within the instruments element of the AS-MPs. For integration of real-time timetable information, vehicles such as busses must be equipped with sensors and the IT in the control centre must be adapted. In practice, for instance, *"especially small bus companies struggle with technical implementation. That sounds so simple real-time, but when one must do it, it is really considerably more complex and complicated"* (PM2). Overall, most interviewees (e.g. AR1, MD3, MD4, OM1, TP1) explained that some of their public transport companies are unable to integrate real-time timetable information into their component mobility service due to the presence of one or more of the identified inhibitors.

5.2 Inhibitors for Service Exchange

Our analysis also focused on the inhibitors for the service exchange action of TTAs and their public transport companies, the second action of their value co-creation activity. If a public transport company conducts a service exchange with a D2D mobility integrator, it becomes a part of its service ecosystem and thus of its activity system (i.e. community), which is denoted as AS-MI.

AS-MI focuses on the provision of a smart mobility service (i.e. object) to better satisfy customers' mobility needs (i.e. outcome). The transformation of several component mobility services (each object of an AS-MP) into a smart mobility service through a D2D mobility integrator (i.e. subject) is mediated by a number of instruments, such as a smartphone app (i.e. a service platform), algorithms, and sensors, which enable a more efficient transformation of the object. Furthermore, the actors of the community, for example, an individual customer, TTAs, and multiple mobility providers such as bike- and car-sharing companies, and their goals influence the transformation. The further mediating elements are the established rules, such as guidelines for packaging the component mobility services and standards for information exchange, as well as the division of labor. For instance, a customer must continuously provide real-time information about her/his current geographical position via the smartphone app.

The interviews with the German TTAs revealed a number of inhibitors for their service exchange action: A first inhibitor (inhibitors are marked bold in the following) concerns the object of the AS-MI (see Fig. 1) and is based on two goals of the TTAs that differ from the goal of the D2D mobility integrator – **(1) to provide smart local mobility in the future themselves, and (2) not to make efforts in the short term to support the provision of supra-regional smart mobility**. A majority of German TTAs and their public transport companies currently *"depend very heavily on pupils"* (MD4, see also AR1, MD5, MD8, OM1), since the state subsidies they receive for free or discounted transport of pupils between home and school represent a large part of their revenues. However, demographic changes in Germany will have a negative impact on the future number of pupils. Hence, to reduce this dependency, TTAs are trying to attract additional customer groups such as commuters.

In recent years, most TTAs have initiated marketing partnerships (e.g. offering price discounts) with local mobility providers such as taxi, bike- or car-sharing companies to make their component mobility services more attractive in comparison to private car use: *"We pass on the information, that's true. So that we simply say: Here, these are the taxi companies, here is the contact information, [and] you can call them. We have been doing this for a very long time"* (MD4), and *"at some point, [name of the car-sharing company] approached us and asked if they could offer our subscription customers a benefit. […]. So, it was initially only a pure marketing cooperation without any money that would have flowed"* (MD5, see also PM2).

Given the new technical possibilities, TTAs themselves plan to offer smart mobility in the future by packaging their own component mobility service and those of their cooperation partners. However, the projects to establish a service platform (usually in form of a smartphone app) are so far mostly in beginning stages (MD3, MD5, MD7, MD8, PM1, PM2, PM3). TTAs in particular struggle to include the component mobility services of the cooperation partners because they have been *"until now also technically a few meters behind in this regard"*, and *"they are to some degree analogue, in terms of the technical equipment of the vehicles, and in terms of their rental system"* (PM2, see also MD1, MD5).

In addition, the TTAs are not willing to conduct a service exchange with a D2D mobility integrator, since their goal – at least in the short term – is not the realization of supra-regional smart mobility. This is because the TTAs have their own histories due to their projects that encompass negative experiences with regard to the object 'smart mobility service': *"this is a very delicate flower, but it is growing. However, in view of the total volume, it is a niche [i.e. "a stable customer base of 1,000 persons"]"* (MD2) and *"the number of users has not grown enormously due to this cooperation"* (MD5). As a result, the TTAs questioned the object of the activity of a D2D mobility integrator: *"therefore we are also a little cautious with initiatives that somehow require all [service] platforms of the world to be connected in order to offer the customers a very high benefit. […]. And that is why our philosophy is initially to make our core business decent – first of all, to make sure that the smart mobility service that we offer here […] that there is a market [for it] at all"* (MD2; see also MD7, MD8). The current small customer group that conducts trips through two or more TTA areas – *"collapsing and breaking out transport are the remaining 3%. This is somewhat clear"* (MD7, see also e.g. MD2, MD3) – also contributes to questioning the object. This inhibitor for the service exchange by TTAs is shown in Fig. 4.

A second inhibitor for the service exchange by TTAs is located in the triangle of subject, object, and community of the AS-MI. The interviewees **expected that a D2D mobility integrator is not able to transform the different component mobility services into a smart mobility service that is attractive for customers** (not an offering that *"will be really successful in the market"* – MD4), since only a few mobility providers belong to the community. This expectation is based on the fact that the majority of the interviewees have not yet been contacted by D2D mobility integrators: *"I think we are actually a bit too small […]. They are not the ones who are coming to us and saying: We want to do something with you!"* (MD4 see also e.g. MD3, MD8). In the case of MD5, this expectation is further supported by the observation of a stagnating development of participation by mobility providers – "*for example, in the case of Qixxit, one has the feeling it will not go any further"* (MD4, see also MD5).

An **expected loss of corporate identity** if component mobility services were packaged into a smart mobility service is a further inhibitor for the service exchange by TTAs. A D2D mobility integrator uses its own service platform (usually a smartphone app) as an instrument to facilitate the transformation. However, the TTAs have a more traditional understanding of the division of labor and see themselves as the direct customer contact. This tension is reflected in their desire that a white label solution, i.e. a smartphone app that is not provided under the brand name of the D2D mobility integrator (e.g. MD1, PM2, TP1), is offered: *"a customer should really see – with the name, with the logo – that s/he is getting there using the public transport in our area. We would like to integrate component mobility services under this framework [i.e. a white label solution]. We did not want to re-invent it, but we're going to give them that and the customer then gets access through us, but actually uses Moovel. But then s/he is not irritated or thinking: What is Moovel? I want to take [the name of the TTA]"* (TP1). This is a *"compromise that one has included this regional element and that it will not become completely anonymous"* (PM1).

A final inhibitor for the service exchange is an **expected overreach** by a D2D mobility integrator. Based on their

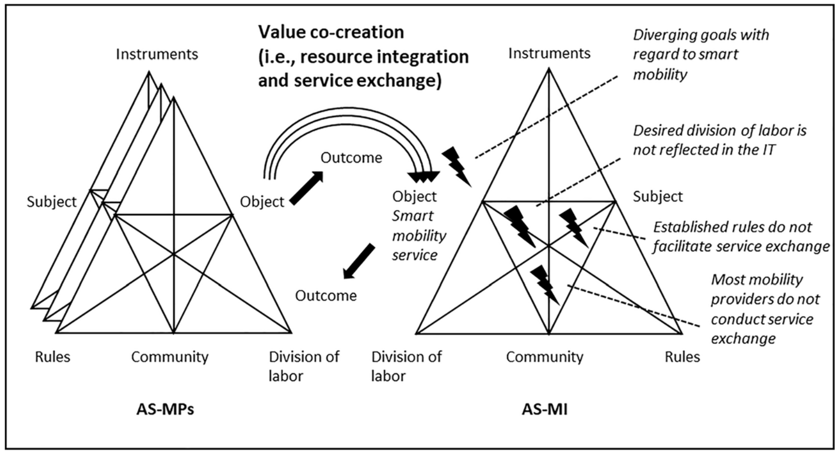


Fig. 4 Inhibitors to Service Exchange

experiences, some TTAs have developed an implicit norm (i.e. rules) that limits their participation in the activity of specific D2D mobility integrators. For example, MD7 had already had negative experiences with the provision of real-time timetable information for the relatively simple timetable information of Deutsche Bahn AG (which is the parent company of the provider of the Qixxit app) in the past: *"The blame is always put on technical problems or mistakes in the delivery by public transport companies and there are mutual recriminations"*. However, *"it can be quite advantageous if I, as Deutsche Bahn AG, prioritize information in my information system about my public transport companies and work with real-time timetable information and integrate information from my competitors, such as private train companies afterwards. But that is a presumption or an accusation"*. In addition, interviewees feared disclosing information that could subsequently be used against them in the case of a tender. For instance, AR1 (see also MD2) stated that *"it is always difficult if a top dog offers something like that. You are always sceptical […] simply because they somehow have some knowledge that they could theoretically use in the next tender"*. As a result, "*it probably has to be a neutral [service] platform"* (MD3). In other words, the provider of the service platform should be a public body or a company outside of the mobility sector.

5.3 Adaptations to Facilitate Value Co-Creation

According to Allen et al. (2013), the contradictions inherent in an activity system can be transformed into congruencies through a process of feedback and action. This idea fits well with the S-D logic perspective, which assumes that by "breaking, making, and maintaining" the institutional arrangements, value co-creation can be increased in a service ecosystem (Koskela-Huotari et al. 2016, p. 2964). In the following, we explain the adaptations made by the TTA of PM2 and a D2D mobility integrator to achieve congruence between the elements of the previously non-interacting activity systems (AS-MP and AS-MI). Shortly before the interview was conducted, the TTA signed a letter of intent with the D2D mobility integrator to sign a contract by the end of the following month. This cooperation has also been made public in the meantime. Given the relatively high consistency of inhibitors that TTAs experience, the case of PM2 can serve as a blueprint.

In our previous results, we showed various inhibitors faced by TTAs that prevent their resource integration and service exchange actions, in other words, the establishment of a value co-creation relationship with a D2D mobility integrator. In the case of PM2, in line with our AT-based S-D logic perspective on value co-creation, its TTA and a D2D mobility integrator have made a number of adaptations in their activity systems to transform the inhibitors into congruencies, and thus to facilitate value co-creation. The trigger for the adaptations was that the TTA questioned the object of its current activity (AS-MP). Due to technological progress and actual customer needs, the TTA considered it no longer appropriate to offer its customers transport between stations. The TTA instead has the goal of providing smart mobility for its local geographical area. In this respect, the TTA differs from the other TTAs that are not currently pursuing this goal or that had already initiated a project to establish a corresponding service platform in the past (e.g. MD2, MD4).

At present, however, due to the mobile ticketing solution (i.e. instrument) adopted, the TTA is not able to efficiently transform the object, and thus to achieve its goal (AS-MP). The interviewee pointed out that the mobile ticketing solution is not suitable for such a purpose, because the provider is not innovative enough – *"pace of innovation leaves a lot to be desired"* (PM2). In addition, the project for the development of an own service platform has just been started, and the *"solution will be available at the earliest in two and a half to three years, and what will we do until then?"* (PM2).

The identified inhibitor, which is located in the upper triangle of the AS-MP, is transformed into a congruence through the feedback provided by the D2D mobility integrator and the corresponding adaptations. A first adaptation was that *"we let our own mobile ticketing expire. […]. We do not have to worry about our own mobile ticketing"* (PM2). From the viewpoint of the complementary S-D logic perspective, this represents a breaking of existing institutional arrangements. By discontinuing the mobile ticketing solution, the provider also leaves the community of the activity. As a result, no mobile tickets can be integrated into the component mobility service (i.e. object) by the TTA. Table 3 shows the adaptations made by the TTA and the D2D mobility integrator to facilitate value co-creation by the TTA.

Adaptations to create congruencies are not, however, limited to the activity system of the TTA (AS-MP). The D2D mobility integrator has also made adaptations to its activity system (AS-MI), so that the TTA is willing to conduct service exchange, and that both activity systems thus become interacted. The goal of the activity of the D2D mobility integrator is still the provision of smart mobility for customers. However, in order to overcome the existing inhibitors for value co-creation (see Fig. 4), a white label smartphone app has been introduced as an instrument: we will *"receive, so to speak, a [name of the TTA] colored [name of the smartphone app]"* and *"it is also the first time that they have offered something like that"* (PM2). The smartphone app includes a ticketing function that enables the integration of mobile tickets into the smart mobility service.

The provision of the white label smartphone app is linked to further adaptations in elements of the AS-MI. The white label smartphone app reflects the desire of the TTAs to maintain direct customer contact (i.e. division of labor), at least from the viewpoint of the customers. There were also adaptations in the case of the community element. Prior to the introduction of the white label smartphone app, the focus was on providing smart mobility for a not further specified group of customers. Because the TTA now acts as a provider in the external presentation to customers, the focus is on the (potential) public transport customers in its local geographical area (i.e. community). The regional focus also ensures that the D2D mobility integrator can provide smart mobility in an efficient way since fewer mobility providers need to be taken into account. In addition, the TTA and its public transport companies already provide a wide range of necessary component mobility services.

6 Discussion

6.1 Theoretical Implications

This article makes five major theoretical contributions to big data and business analytics (Pappas et al. 2018; Mikalef et al. 2020), smart integrator (Alt et al. 2019) and S-D logic literature (Vargo and Lusch 2017; Brust et al. 2017). First, we contribute to the *understanding of actors in big data and business analytics ecosystems*, as called for by Pappas et al. (2018). In the past, big data and business analytics approaches have been implemented in particular to solve technical and business challenges. Less research has considered how actors in big data and business analytics ecosystems exchange data, information and knowledge in order to drive digital transformation and create sustainable societies, for instance, with regard to environmental sustainability (e.g., mitigation of noise and air pollution that is caused by private cars) (Pappas et al. 2018; Gupta et al. 2018). Our study provides insights into the

Table 3 Adaptations to Facilitate Value Co-Creation

Form of adaptation	Affected element (part of the interacting activity systems)	Explanation
Addition	Community (AS-MI)	By conducting resource integration and service exchange, the TTA and its public transport companies become members of the community.
Modification	Community (AS-MI)	A new focus on the (potential) customers of the TTA and its public transport companies.
	Division of labor (AS-MI)	Due to the white label smartphone app, the TTA is able to maintain direct customer contact.
	Instrument (AS-MI)	Introduction of a white label smartphone app.
	Object (AS-MI)	The new goal is to provide smart local mobility on behalf of the TTA. Now provision of a smart local mobility service, including the integration of mobile tickets.
	Object (AS-MP)	The new goal is to provide smart local mobility. Now provision of a component mobility service without the integration of mobile tickets.
Substitution	Community (AS-MP)	The business relationship with the mobile ticketing provider is terminated.
	Instrument (AS-MP)	Termination of the mobile ticketing solution.

attributes and beliefs of German TTAs, which enhance our knowledge of their behavior, capabilities and needs, as well as on the data they generate and how they interact. In addition, by focusing on the lacking data exchange between TTAs (public) and a D2D mobility integrator (private), our research complements studies that analyze public, respectively, private actor relationships (e.g., Klievink et al. 2017; Popovič et al. 2018; Côrte-Real et al. 2020).

Second, we contribute to *research on smart integrators*, especially in a mobility context, which is in the fledgling stage and has only received limited attention by scholars to date. Existing work provides a market overview on the current development stage of the smartphone apps of D2D mobility integrators, but does not explain the provision of non-smart mobility services (Albrecht and Ehmke 2016; Willing et al. 2017a, 2017b). Other studies showed that mobility providers often do not have the necessary resources, such as mobile tickets and real-time timetable information (Schulz et al. 2018), or do not make them available, for example due to a lack of pressure for legitimation (Schulz and Überle 2018). What has been missing to date is a study on how to initiate a business relationship between a mobility provider and a D2D mobility integrator.

Our third contribution is the *integration of AT and the S-D logic perspective*. AT has been successfully applied in a number of research fields (Kuutti 1996; Kaptelinin 1996; Jarzabkowski 2003; Blackler et al. 2000; Engeström 2000a, etc.), including IS (e.g., Hasan et al. 2017; Allen et al. 2013; Karanasios and Allen 2013, 2014; Sun 2020; Slavova and Karanasios 2018; Malaurent and Karanasios 2020). The focus was already on work activities of individuals, teams, and companies (Karlsson and Wistrand 2006; Korpela et al. 2004; Zott and Amit 2009; Engeström 2000b). In contrast, the S-D logic perspective and its concept of value co-creation are meta-theoretical in nature today, making their "direct testing, verification, and application" difficult (Vargo and Lusch 2017, p. 50). By complementing the S-D logic perspective with AT, we follow the recent call to use theories outside of marketing to develop the S-D logic perspective towards midrange theory (Vargo and Lusch 2017; Schulz et al. 2020). In doing so, we rely on the argumentation of Vargo and Lusch (2017) that resource integration and service exchange are the two building blocks of value co-creation. This is in line with the assumption that actor engagement (which is defined as the disposition of an actor to engage and its activity of integrating resources) can be used as a microfoundation for value co-creation (Storbacka et al. 2016).

Based on literature from different service fields such as education, finance, and mobility (Nueesch et al. 2014; Zhang et al. 2006, etc.), we show that resource integration and service exchange of service providers (i.e. their value co-creation) can be analyzed using an interacting activity systems perspective. With this AT-based S-D logic perspective on value co-creation, we provide a blueprint for the analysis of (lacking) value co-creation between actors embedded in different service ecosystems. Since the instruments element of an activity system can map the concept of the service platform from the S-D logic perspective, the blueprint can help researchers to shed light on value co-creation of actors in a technology-enabled service context that we currently know little about (Breidbach and Maglio 2016).

Fourth, we show that the AT-related *concept of contradictions* (Engeström 1987) can be used *to identify inhibitors* that represent manifestations of contradictions, which affect value co-creation by service providers. Initially, based on exemplary inhibitors for value co-creation described in scientific literature (e.g., Schmidt-Rauch and Nussbaumer 2011; Aarikka-Stenroos and Jaakkola 2012), we illustrate that these inhibitors are located within elements, between them, or between elements of different activity systems. Subsequently, we have checked this theoretical derivation with our qualitative study. The interviews confirmed that the concept of contradictions can be applied to identify inhibitors for value co-creation faced by German TTAs and thus hinder the provision of smart mobility. With this theoretical contribution, we extend the work of Schulz et al. (2020), who adopted AT thinking for analyzing value co-creation, but without drawing on interacting activity systems as the unit of analysis (Engeström 2001), and not referring to the different levels of contradictions (Engeström 1987).

Our final theoretical contribution is to show how *inhibitors are transformed into congruencies* (Allen et al. 2013) through a process of feedback and action that facilitate the value co-creation by a TTA. According to the S-D logic perspective, "breaking, making, and maintaining the institutionalized rules of resource integration" (Koskela-Huotari et al. 2016, p. 2964) leads to new opportunities for value co-creation in a service ecosystem. By drawing on AT, we can provide a broader theoretical foundation by showing that the actors transform inhibitors for value co-creation through adding, substituting, or modifying activity system(s) elements into congruencies. In the case of PM2, its TTA and a D2D mobility integrator have initiated a number of adaptations. In particular, the desire of the TTA to offer smart local mobility in the short term and the simultaneous inability of the D2D mobility integrator to provide smart mobility for customers can be seen as the starting point for adaptations. Although we could only observe how inhibitors are transformed into congruencies in this case, the statement of MD1 – *"we had [...] a system decision here. Either we extend the electronic timetable information that we have been using for more than 20 years or we switch to an external mobility [service] platform"* – also supports our AT-based thinking that inhibitors can serve as triggers for adaptations that facilitate value co-creation.

6.2 Practical Implications

Our study provides a number of practical contributions. Initially, we *improve practitioners' knowledge on IT-enabled value co-creation* in service ecosystems in general by introducing our AT-based S-D logic perspective. In different service sectors, such as education, finance, health, and mobility, a single service provider is often not able to meet the actual customer needs (Alt et al. 2019). Technological progress has the potential to foster value co-creation between different service providers by developing "technologies [for example service platforms] that rely on sensors, big data, open data, new ways of connectivity and exchange of information (e.g., Internet of Things, RFID, and NFC) as well as abilities to infer and reason" (Gretzel et al. 2015, p. 179). However, little advice is offered in S-D logic literature to date on how value co-creation can be put into practice (Giesbrecht et al. 2017; Vargo and Lusch 2017).

By adopting AT as complementary theoretical lens, we highlight the elements – the six elements of each activity system – that practitioners need to take into consideration. In addition, we create an awareness that these elements are linked and cannot be viewed separately from each other (Engeström 1987, 2001). This awareness is particularly important when a new IT is adopted by the actors of a service ecosystem in the course of technological progress in order to identify possible inhibitors for value co-creation in advance and to initiate necessary adaptations.

In addition, the AT-based S-D logic perspective reflects a theory-based blueprint that can be used by practitioners of all service fields to systematically analyze the two underlying actions of the value co-creation activity – resource integration and service exchange. On the basis of the interviews with the German TTAs, we exemplarily show how the general elements of the interacting activity systems need to be specified during the analysis. Building on this, we identified the *inhibitors* to *resource integration* on the part of the TTAs and their public transport companies. In the case of the lacking integration of mobile tickets and of real-time timetable information, our results show, for example, that the existing IT is not capable of supporting mobile ticketing and that there is a tension between the provision of a high-quality and cost-effective component mobility service caused by differing rules. Practitioners can use the results to initiate actions for the mitigation and resolution of the inhibitors to resource integration.

The AT-based S-D logic perspective on value co-creation also gives practitioners insights into possible *solutions* to the problems of inhibitors for *resource integration* faced by service providers. In the case of the lacking resource integration by German TTAs, the regional authorities as their frequent shareholders (Reinhardt 2012), and thus members of the community element of the activity system, play a central role in our considerations. Due to their position, they should have, for example, the power to initiate and enforce a change of rules. For instance, they can ensure that the implementation of a mobile ticketing solution becomes more economically attractive for public transport companies by advocating that earnings allocation contracts are adapted appropriately and a commission agreement for ticket sales is introduced. In addition, with regard to the integration of real-time timetable information, the regional authorities can use their influence to enforce the use of gross tendering. If public transport companies receive a (higher) fixed price for the provision of their component mobility service, they can be obliged to integrate real-time timetable information.

The AT-based S-D logic perspective on value co-creation can also be used by practitioners to identify *inhibitors* to *service exchange* that are faced by service providers. Our results show that TTAs and their public transport companies do not currently conduct service exchange with a D2D mobility integrator because they wish, for instance, to maintain direct customer contact (i.e. to retain the traditional division of labor). However, this wish is not reflected in the smartphone app integrated by D2D mobility integrators.

A further practical contribution is that on the basis of the AT-based S-D logic perspective, *solutions* can be proposed to overcome the *inhibitors for service exchange*. A theory-based recommendation could be that the regional authorities should prevent negative service exchange decisions of TTAs that are guided by their goal to provide smart local mobility in the future themselves and the perceived lack of necessity to make efforts in the short term to support the provision of supra-regional smart mobility. Such attempts to defend 'local empires', and the associated lack of focus on actual customer needs contribute to the attractiveness of private car use. As a result, cities continue to face such problems as traffic congestion, parking problems as well as noise and air pollution (Willing et al. 2017a, 2017b; Gupta et al. 2019; Benevolo et al. 2016; Schreieck et al. 2018).

While theory-based recommendations for facilitating resource integration and service exchange of service providers are possible based on the AT-based S-D logic perspective, we can also provide a *real-world case* (PM2) for mobility providers that can serve as blueprint for other practitioners. Our results show how the TTA and the D2D mobility integrator each adapted their activity system. The mobility provider, for example, no longer integrates mobile tickets, however, makes its component mobility service available to the D2D mobility integrator. The D2D mobility integrator, in turn, now provides a white label smartphone app and integrates mobile tickets into smart local mobility service. We assume that the D2D mobility integrator is able to facilitate value co-creation by other TTAs through the integration of other resources. For instance, Willing et al. (2017a, p. 277) emphasized that "generated data on [service platforms] creates the unique opportunity for service providers [i.e., mobility providers] to analyze how their individual business model performs in the context of competing and complementary services". Based on the results of big data analytics, TTAs can for example leave the final pricing to the D2D mobility integrator (Schulz et al. 2018).

The recommendations made so far aim at increasing the quality of data generated by TTAs and improving data access for D2D mobility integrators, but there is also a need to *improve the big data analytics capability of both actors*. According to Pappas et al. (2018), this includes the developing a data-driven culture, investing in appropriate technology, facilitating technical and managerial skills, and promoting a climate of organizational learning. This capability enables the actors to generate value from big data and to achieve business and societal change. Hence, a strong big data analytics capability is key for digital transformation and the creation of sustainable societies.

To develop big data analytics capability, D2D mobility integrators should, for example, hire a workforce with extensive technical and managerial skills in big data analytics. Since D2D mobility integrators are often start-ups (Albrecht and Ehmke 2016) competing with well-established companies for the most qualified talent, D2D mobility integrators should offer attractive salaries, benefits, working conditions and training opportunities. In the long term, strategic educational reform in big data analytics is needed to develop qualified talent (Watson 2019), possibly modelled after new curricula proposed by Gupta et al. (2015) and Wilder and Ozgur (2015).

For TTAs currently focused on providing public transportation, a new data-driven culture among employees is needed to participate actively in big data and business analytics ecosystems. This need is bolstered by studies (e.g., Klievink et al. 2017; Okwechime et al. 2018) finding big data analytics capability to be less present in public organizations than in private companies and by studies (e.g., Davenport and Bean 2018) showing that established companies can find it more difficult to shift to a data-driven culture than start-ups adopting a data-driven culture from their beginning. One way to promote a data-driven culture is to assign management roles focussing on big data and business analytics (Davenport and Bean 2018). A stronger data-driven culture among TTAs increases the quantity and quality of data that, in turn, facilitate value creation among actors (Côrte-Real et al. 2020), leading to business and societal change and the creation of sustainable societies (Pappas et al. 2018).

6.3 Limitations and Future Research

In our study, we adopted the S-D logic perspective to analyze the (lack of) value co-creation of German TTAs and their public transport companies. Originally introduced into marketing (Vargo and Lusch 2004), the S-D logic perspective has since been used by scholars from many different research fields, including IS (see Brust et al. 2017 for an overview). In addition, some of the previous studies have focused on mobility (e.g., Hein et al. 2018; Schulz and Überle 2018; Alexander and Jaakkola 2011; Echeverri and Skålén 2011; Schulz et al. 2020). However, there are numerous other perspectives and theories that also deal with the concept of value co-creation (Kohtamäki and Rajala 2016; Reypens et al. 2016). While we make an important theoretical contribution to develop the S-D logic perspective towards a midrange theory and framework, as requested by Vargo and Lusch (2017), it is unclear how the explanatory power of the S-D logic perspective is in comparison to the other perspectives and theories.

A similar argument concerns the choice of AT as complementary theory. As recommended, AT does not originate from marketing (Vargo and Lusch 2017) and has already been used to analyze work activities at the team and (cross-) company level (Karlsson and Wistrand 2006; Korpela et al. 2004; Engeström 2000b; Schulz et al. 2020). Nevertheless, the choice of a different complementary theory may cause varying results. Future research should address the question concerning in which cases the use of the AT-based S-D logic perspective leads to superior results.

The empirical data used in this study was only collected from the German mobility sector and the results may therefore not be directly transferable to other countries and fields of service. Although the mobility sector is regarded to be an important area for smart integrators (Alt et al. 2019), and the concept of smart mobility is considered to be very advanced in Europe and especially in Germany (Willing et al. 2017b), further research needs to prove the generalizability of our results. An interesting setting may be found in the medical tourism sector, in which (smart) integrators package different component services like medical treatment, translation, accommodation and transfer (Connell 2006).

Our approach of conducting qualitative interviews with experts is recommended and acknowledged in research fields that undergo a great deal of change (Flick 2009). As a next step however, further qualitative as well as quantitative analyses are needed to ensure the validity of our results. The timeframe of our data collection was also limited. We were only able to take snapshots of the initiated adaptations to create congruencies. Future research should employ longitudinal studies to track the process of feedback and action over a longer period of time.

Lastly, even though component mobility services of TTAs and their public transport companies are considered an important part of smart mobility (Willing et al. 2017b), future research should examine the activity systems of further mobility providers such as taxi and bike-sharing companies. In addition, the value co-creation relationship between a D2D mobility integrator and a customer requires more detailed investigation. Because our AT-based S-D logic perspective on value co-creation can also be used from a customer perspective instead of, or in addition to, a mobility provider perspective, it can serve as a theoretical foundation.

7 Conclusion

D2D mobility integrators currently fail to provide truly smart mobility. However, our understanding regarding the lack of value co-creation by the mobility providers as the root cause, as well as our knowledge of possible solutions is limited. We contribute to closing these research gaps by adopting an AT-based S-D logic perspective to analyze the lack of value co-creation by German TTAs and their public transport companies. Based on this, we can identify different inhibitors for their resource integration and service exchange actions that constitute their value co-creation activity. Our results also show how a TTA and a D2D mobility integrator have started a series of adaptations to put value co-creation into practice.

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References

Aarikka-Stenroos, L., & Jaakkola, E. (2012). Value co-creation in knowledge intensive business services: A dyadic perspective on the joint problem solving process. *Industrial Marketing Management, 41*(1), 15–26.

Ahlers, D., Akerkar, R., Krogstie, J., Opdahl, A. L., Tessem, B., & Zhang, W. (2018). *Harnessing mobility data in cities: A case study from the Bergen region*. Svalbard: Norsk konferanse for organisasjoners bruk av informasjonsteknologi.

Akande, A., Cabral, P., & Casteleyn, S. (2019). Assessing the gap between technology and the environmental sustainability of European cities. *Information Systems Frontiers, 21*, 581–604.

Albrecht, L., & Ehmke, J. F. (2016). *Innovative Services in der Mobilitätsbranche: Eine Marktanalyse multimodaler Mobilitätsmanager*. Ilmenau: Multikonferenz Wirtschaftsinformatik.

Alexander, M., & Jaakkola, E. (2011). *Exploring value co-creation within networks: Actor-to-actor service provision within a public transport service system*. Glasgow: Industrial Marketing and Purchasing Conference.

Allen, D. K., Brown, A., Karanasios, S., & Norman, A. (2013). How should technology-mediated organizational change be explained? A comparison of the contributions of critical realism and activity theory. *MIS Quarterly, 37*(3), 835–854.

Alt, R., Ehmke, J. F., Haux, R., Henke, T., Mattfeld, D. C., Oberweis, A., Paech, B., & Winter, A. (2019). Towards customer-induced service orchestration - requirements for the next step of customer orientation. *Electronic Markets, 29*(1), 79–91.

Beirão, G., & Cabral, J. A. S. (2007). Understanding attitudes towards public transport and private car: A qualitative study. *Transport Policy, 14*, 478–489.

Benevolo, C., Dameri, R. P., & D'Auria, B. (2016). Smart mobility in smart city: Action taxonomy, ICT intensity and public benefits. In T. Torre, A. M. Braccini, & R. Spinelli (Eds.), *Empowering organizations: Enabling platforms and Artefacts* (pp. 13–28). Cham: Springer.

Blackler, F., Crump, N., & McDonald, S. (2000). Organizing processes in complex activity networks. *Organization, 7*(2), 277–300.

Breidbach, C. F., & Maglio, P. P. (2016). Technology-enabled value co-creation: An empirical analysis of actors, resources, and practices. *Industrial Marketing Management, 56*, 73–85.

Brust, L., Breidbach, C. F., Antons, D., & Salge, T. O. (2017). *Service-dominant logic and information systems research: A review and analysis using topic modeling*. Seoul: International Conference on Information Systems.

Connell, J. (2006). Medical tourism: Sea, sun, sand and … surgery. *Tourism Management, 27*(6), 1093–1100.

Côrte-Real, N., Ruivo, P., & Oliveira, T. (2020). Leveraging internet of things and big data analytics initiatives in European and American firms: Is data quality a way to extract business value? *Information & Management, 57*(1), 103141.

Dai, H., Ge, L., & Liu, Y. (2018). Information matters: An empirical study of the efficiency of on-demand services. *Information Systems Frontiers.*

Davenport, T. H., & Bean, R. (2018). Big companies are embracing analytics, but most still don't have a data-driven culture. Harvard Business Review.

Davydov, V. V., Zinchenko, V. P., & Talyzina, N. F. (1983). The problem of activity in the works of a. N. Leont'ev. *Soviet Psychology, 21*(4), 31–42.

de Reuver, M., Bouwman, H., & Haaker, T. (2009). Mobile business models: Organizational and financial design issues that matter. *Electronic Markets, 19*(1), 3–13.

Dennehy, D., & Conboy, K. (2020). Breaking the flow: A study of contradictions in information systems development (ISD). *Information Technology & People, 33*(2), 477–501.

Dionne, P., & Bourdon, S. (2018). Contradictions as the driving force of collective and subjective development group employment programmes. *Journal of Education and Work, 31*(3), 277–290.

Echeverri, P., & Skålén, P. (2011). Co-creation and co-destruction: A practice-theory based study of interactive value formation. *Marketing Theory, 11*(3), 351–373.

Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *Academy of Management Journal, 50*(1), 25–32.

Elliot, S. (2011). Transdisciplinary perspectives on environmental sustainability: A resource base and framework for IT-enabled business transformation. *MIS Quarterly, 35*(1), 197–236.

Engeström, Y. (1987). *Learning by expanding: An activity-theoretical approach to developmental research*. Orienta-Konsultit: Helsinki.

Engeström, Y. (1993). Developmental studies of work as a testbench of activity theory: The case of primary care medical practice. In S. Chaiklin & J. Lave (Eds.), *Understanding practice: Perspectives on activity and context* (pp. 64–103). Cambridge: Cambridge University Press.

Engeström, Y. (2000a). Activity theory and the social construction of knowledge: A story of four umpires. *Organization, 7*(2), 301–310.

Engeström, Y. (2000b). Activity theory as a framework for analyzing and redesigning work. *Ergonomics, 43*(7), 960–974.

Engeström, Y. (2001). Expansive learning at work: Toward an activity theoretical reconceptualization. *Journal of Education and Work, 14*(1), 133–156.

Engeström, Y., & Sannino, A. (2011). Discursive manifestations of contradictions in organizational change efforts. A methodological framework. *Journal of Organizational Change Management, 24*(3), 368–387.

Flick, U. (2009). *An introduction to qualitative research*. London: SAGE Publications.

Follmer, R., & Gruschwitz, D. (2019). Mobilität in Deutschland - MiD Kurzreport.

Gebauer, H., Johnson, M., & Enquist, B. (2010). Value co-creation as a determinant of success in public transport services: A study of the Swiss federal railway operator (SBB). *Managing Service Quality, 20*(6), 511–530.

Giesbrecht, T., Schwabe, G., & Schenk, B. (2017). Service encounter thinklets: How to empower service agents to put value co-creation into practice. *Information Systems Journal, 27*(2), 171–196.

Gilsing, R., Turetken, O., Adali, O. E., & Grefen, P. A. (2018). *Reference model for the design of service-dominant business models in the smart mobility domain*. San Francisco: International Conference on Information Systems.

Gretzel, U., Sigala, M., Xiang, Z., & Koo, C. (2015). Smart tourism: Foundations and developments. *Electronic Markets, 25*(3), 179–188.

Gupta, A., Deokar, A., Iyer, L., Sharda, R., & Schrader, D. (2018). Big data & analytics for societal impact: Recent research and trends. *Information Systems Frontiers, 20*, 185–194.

Gupta, B., Goul, M., & Dinter, B. (2015). Business intelligence and big data in higher education: Status of a multi-year model curriculum development effort for business school undergraduates, MS graduates, and MBAs. *Communications of the Association for Information Systems, 36*.

Gupta, P., Chauhan, S., & Jaiswal, M. P. (2019). Classification of smart city research - a descriptive literature review and future research agenda. *Information Systems Frontiers, 21*, 661–685.

Hasan, H., Smith, S., & Finnegan, P. (2017). An activity theoretic analysis of the mediating role of information systems in tackling climate change adaptation. *Information Systems Journal, 27*(3), 271–308.

Hein, A., Scheiber, M., Böhm, M., Weking, J., Rocznik, D., & Krcmar, H. (2018). *Toward a design framework for service-platform ecosystems*. Portsmouth: European Conference on Information Systems.

Hein, A., Weking, J., Schreieck, M., Wiesche, M., Böhm, M., & Krcmar, H. (2019). Value co-creation practices in business-to-business platform ecosystems. *Electronic Markets, 29*(3), 503–518.

Hildebrandt, B., Hanelt, A., & Firk, S. (2018). Sharing yet caring: Mitigating moral hazard in access-based consumption through IS-enabled value co-capturing with consumers. *Business & Information Systems Engineering, 60*(3), 227–241.

Jarzabkowski, P. (2003). Strategic practices: An activity theory perspective on continuity and change. *Journal of Management Studies, 40*(1), 23–55.

Kaptelinin, V. (1996). Computer-mediated activity: Functional organs in social and developmental contexts. In B. A. Nardi (Ed.), *Context and consciousness: Activity theory and human-computer interaction* (pp. 45–68). Cambridge: The MIT Press.

Karanasios, S., & Allen, D. (2013). ICT for development in the context of the closure of Chernobyl nuclear power plant: An activity theory perspective. *Information Systems Journal, 23*(4), 287–306.

Karanasios, S., & Allen, D. (2014). Mobile technology in mobile work: Contradictions and congruencies in activity systems. *European Journal of Information Systems, 23*(5), 529–542.

Karlsson, F., & Wistrand, K. (2006). Combining method engineering with activity theory: Theoretical grounding of the method component concept. *European Journal of Information Systems, 15*(1), 82–90.

Klievink, B., Romijn, B.-J., Cunningham, S., & de Bruijn, H. (2017). Big data in the public sector: Uncertainties and readiness. *Information Systems Frontiers, 19*, 267–283.

Kohtamäki, M., & Rajala, R. (2016). Theory and practice of value co-creation in B2B systems. *Industrial Marketing Management, 56*, 4–13.

Korpela, M., Mursu, A., Soriyan, A., Eerola, A., Häkkinen, H., & Toivanen, M. (2004). Information systems research and development by activity analysis and development: Dead horse or the next wave? In B. Kaplan, D. P. Truex III, D. Wastell, A. T. Wood-Harper, & J. I. DeGross (Eds.), *Information systems research: Relevant theory and informed practice* (pp. 453–471). New York: Kluwer Academic Publishers.

Koskela-Huotari, K., Edvardsson, B., Jonas, J. M., Sörhammar, D., & Witell, L. (2016). Innovation in service ecosystems—Breaking, making, and maintaining institutionalized rules of resource integration. *Journal of Business Research, 69*(8), 2964–2971.

Kottow, M. H. (1986). Medical confidentiality: An intransigent and absolute obligation. *Journal of Medical Ethics, 12*(3), 117–122.

Kuutti, K. (1996). Activity theory as a potential framework for human-computer interaction research. In B. A. Nardi (Ed.), *Context and consciousness. Activity theory and human-computer interaction* (pp. 17–44). London: Massachusetts Institute of Technology.

Leont'ev, A. N. (1978). *Activity, consciousness, and personality*. Englewood Cliffs: Prentice-Hall.

Lusch, R. F., & Nambisan, S. (2015). Service innovation: A service-dominant logic perspective. *MIS Quarterly, 39*(1), 155–175.

Malaurent, J., & Karanasios, S. (2020). Learning from workaround practices: The challenge of enterprise system implementations in multinational corporations. *Information Systems Journal, 30*(4), 639–663.

Mikalef, P., Pappas, I., Krogstie, J., & Pavlou, P. (2020). Big data and business analytics: A research agenda for realizing business value. *Information & Management, 57*(1), 103237.

Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative data analysis: A methods sourcebook*. Los Angeles: SAGE Publications.

Minkiewicz, J., Bridson, K., & Evans, J. (2016). Co-production of service experiences: Insights from the cultural sector. *Journal of Services Marketing, 30*(7), 749–761.

Nueesch, R., Puschmann, T., & Alt, R. (2014). *Realizing value from tablet-supported customer advisory: Cases from the banking industry*. Bled: Bled eConference.

Nunes, A. A., Galvão, T., & e Cunha, J. F. (2014). Urban public transport service co-creation: Leveraging passenger's knowledge to enhance travel experience. *Procedia - Social and Behavioral Sciences, 111*(5), 577–585.

Okwechime, E., Duncan, P., & Edgar, D. (2018). Big data and smart cities: A public sector organizational learning perspective. *Information Systems and e-Business Management, 16*, 601–625.

Pappas, I. O., Mikalef, P., Giannakos, M. N., Krogstie, J., & Lekakos, G. (2018). Big data and business analytics ecosystems: Paving the way towards digital transformation and sustainable societies. *Information Systems and e-Business Management, 16*(3), 479–491.

Payne, A. F., Storbacka, K., & Frow, P. (2008). Managing the co-creation of value. *Journal of the Academy of Marketing Science, 36*(1), 83–96.

Popovič, A., Hackney, R., Tassabehji, R., & Castelli, M. (2018). The impact of big data analytics on firms' high value business performance. *Information Systems Frontiers, 20*(2), 209–222.

Pulkkinen, J., Jussila, J., Partanen, A., Trotskii, I., & Laiho, A. (2019). Smart mobility: Services, platforms and ecosystems. *Technology Innovation Management Review, 9*(9), 15–25.

Rahman, M., Bose, S., Babu, M. M., Dey, B. L., Roy, S. K., & Binsardi, B. (2019). Value co-creation as a dialectical process: Study in Bangladesh and indian province of West Bengal. *Information Systems Frontiers, 21*(3), 527–545.

Reinhardt, W. (2012). *Öffentlicher Personennahverkehr: Technik - rechtliche und betriebswirtschaftliche Grundlagen*. Wiesbaden: Vieweg+Teubner Verlag.

Reypens, C., Lievens, A., & Blazevic, V. (2016). Leveraging value in multi-stakeholder innovation networks: A process framework for value co-creation and capture. *Industrial Marketing Management, 56*, 40–50.

Schmidt-Rauch, S., & Nussbaumer, P. (2011). *Putting value co-creation into practice: A case for advisory support*. European Conference on Information Systems: Helsinki.

Schreieck, M., Pflügler, C., Setzke, D. S., Wiesche, M., & Krcmar, H. (2018). Improving urban transportation: An open platform for digital mobility services. In C. Linnhoff-Popien, R. Schneider, & M. Zaddach (Eds.), *Digital marketplaces unleashed* (pp. 479–489). Berlin: Springer.

Schulz, T., Böhm, M., Gewald, H., Celik, Z., & Krcmar, H. (2020). The negative effects of institutional logic multiplicity on service platforms in intermodal mobility ecosystems. *Business & Information Systems Engineering*.

Schulz, T., Gewald, H., & Böhm, M. (2018). *The long and winding road to smart integration of door-to-door mobility services: An analysis of the hindering influence of intra-role conflicts*. Portsmouth: European Conference on Information Systems.

Schulz, T., & Überle, M. (2018). *How institutional arrangements impede realization of smart ecosystems: The case of door-to-door mobility integrators*. Portsmouth: European Conference on Information Systems.

Slavova, M., & Karanasios, S. (2018). When institutional logics meet information and communication technologies: Examining hybrid information practices in Ghana's agriculture. *Journal of the Association for Information Systems, 19*(9), 775–812.

Storbacka, K., Brodie, R. J., Böhmann, T., Maglio, P. P., & Nenonen, S. (2016). Actor engagement as a microfoundation for value co-creation. *Journal of Business Research, 69*(8), 3008–3017.

Su, N. (2013). Internationalization strategies of Chinese IT service suppliers. *MIS Quarterly, 37*(1), 175–200.

Sun, J. (2020). Ubiquitous computing capabilities and user-system interaction readiness: An activity perspective. *Information Systems Frontiers, 22*, 259–271.

Turetken, O., Grefen, P., Gilsing, R., & Adali, O. E. (2019). Service-dominant business model design for digital innovation in smart mobility. *Business & Information Systems Engineering, 61*(1), 9–29.

United Nations Department of Economic and Social Affairs (2015). World urbanization prospects.

Vargo, S. L., & Lusch, R. F. (2004). Evolving to a new dominant logic for marketing. *Journal of Marketing, 68*(1), 1–17.

Vargo, S. L., & Lusch, R. F. (2017). Service-dominant logic 2025. *International Journal of Research in Marketing, 34*(1), 46–67.

Vargo, S. L., Maglio, P. P., & Akaka, M. A. (2008). On value and value co-creation: A service systems and service logic perspective. *European Management Journal, 26*(3), 145–152.

Verband Deutscher Verkehrsunternehmen (2018). 2017 Statistik.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge: Harvard University Press.

Watson, H. J. (2019). Update tutorial: Big data analytics: Concepts, technology, and applications. *Communications of the Association for Information Systems, 44*.

Watson, R. T., Boudreau, M.-C., & Chen, A. J. (2010). Information systems and environmentally sustainable development: Energy informatics and new directions for the IS community. *MIS Quarterly, 34*(1), 23–38.

Watson, R. T., Boudreau, M.-C., Chen, A. J., & Sepúlveda, H. H. (2011). Green projects: An information drives analysis of four cases. *Journal of Strategic Information Systems, 20*(1), 55–62.

Wikipedia (2016). Liste deutscher Tarif- und Verkehrsverbünde. https://de.wikipedia.org/wiki/Liste_deutscher_Tarif-_und_Verkehrsverb%C3%BCnde. Accessed 2016-09-23.

Wilder, C. R., & Ozgur, C. O. (2015). Business analytics curriculum for undergraduate majors. *INFORMS Transactions on Education, 15*(2), 180–187.

Willing, C., Brandt, T., & Neumann, D. (2017a). Electronic mobility market platforms – A review of the current state and applications of business analytics. *Electronic Markets, 27*(3), 267–282.

Willing, C., Brandt, T., & Neumann, D. (2017b). Intermodal mobility. *Business & Information Systems Engineering, 59*(3), 173–179.

Winkler, T. J., & Wulf, J. (2019). Effectiveness of IT service management capability: Value co-creation and value facilitation mechanisms. *Journal of Management Information Systems, 36*(2), 639–675.

Winter, A., Alt, R., Ehmke, J., Haux, R., Ludwig, W., Mattfeld, D., Oberweis, A., & Paech, B. (2012). Manifest–Kundeninduzierte Orchestrierung komplexer Dienstleistungen. *Informatik-Spektrum, 35*(6), 399–408.

Yin, J., Qian, L., & Shen, J. (2019). From value co-creation to value co-destruction? The case of dockless bike sharing in China. *Transportation Research Part D: Transport and Environment, 71*, 169–185.

Yin, R. K. (2014). *Case study research: Design and methods*. Thousand Oaks: SAGE Publications.

Zhang, D., Zhou, L., Briggs, R. O., & Nunamaker Jr., J. F. (2006). Instructional video in e-learning: Assessing the impact of interactive video on learning effectiveness. *Information & Management, 43*(1), 15–27.

Zott, C., & Amit, R. (2009). Business model design: An activity system perspective. *Long Range Planning, 43*(2), 216–226.

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Appendix J. The Negative Effects of Institutional Logic Multiplicity on Service Platforms in Intermodal Mobility Ecosystems (P8)

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RESEARCH PAPER

The Negative Effects of Institutional Logic Multiplicity on Service Platforms in Intermodal Mobility Ecosystems

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Abstract Digitalization is changing the mobility sector. Companies have developed entirely new mobility services, and mobility services with pre-digital roots, such as ride-sharing and public transport, have leveraged digitalization to become more convenient to use. Nevertheless, private car use remains the dominant mode of transport in most developed countries, leading to problems such as delays due to traffic congestion, insufficient parking spaces, as well as noise and air pollution. Emerging intermodal mobility ecosystems take advantage of digital advances in mobility services by providing individual, dynamic and context-aware combinations of different mobility services to simplify door-to-door mobility and contribute to the reduction of private car use. However, the service platforms are limited in terms of functional range, for example they may lack integrated ticketing and rely on static data, which makes intermodal mobility inconvenient. This article adopts the service-dominant logic perspective to analyze service ecosystems for intermodal mobility and their service provision. Drawing on traditional institutional literature, the authors question the assumption that service logic is dominant for all actors of a service ecosystem. By applying activity theory, the article illustrates how an institutional logic multiplicity among actors can negatively affect the functional range of service platforms. The results of a qualitative study in Germany show that, in particular, the state logic of some actors, which is characterized by the obligation to provide mobility, impairs the quality of service platforms in supporting citizens in intermodal mobility.

Keywords Intermodal mobility · Logic multiplicity · Service-dominant logic · Service ecosystem

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1 Introduction

Urban mobility is at a turning point. Almost every city in economically more developed countries is challenged by high traffic volume caused by the predominant use of the private car. For example, in Rome, Dublin, Paris and London, car drivers spend on average more than 200 h a year waiting in traffic (INRIX 2019). Other negative effects include insufficient parking spaces (Giuffrè et al. 2012), as well as air and noise pollution (Barth and Boriboonsomsin 2008; Willing et al. 2017a, b). Without significant structural changes, private car traffic volume is expected to continue to increase and more cities will face such challenges as their populations increase (United Nations Department of Economic and Social Affairs 2015).

Technical progress and digitalization have driven the development of viable alternatives to the use of private cars

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with a combustion engine. For example, electric cars reduce air and noise pollution. However, one obstacle to their proliferation is the need for a resilient charging infrastructure (Hoerstebrock and Hahn 2014). Further examples include mobility services such as car-sharing (Firnkorn and Müller 2011; Hildebrandt et al. 2015), bike-sharing (Shaheen et al. 2010), and ride-sharing (Teubner and Flath 2015), which make better use of resources. Information technology (IT) such as sensors and the proliferation of smartphones have made these shared mobility services easier and more convenient to use. In larger cities, in particular, citizens often have access to a range of mobility services in addition to station-based public transport. Combining different mobility services can help overcome the disadvantages of individual mobility services. For example, bike-sharing can alleviate the problem of a long walking time resulting from the station-based nature of public transport (Beirão and Cabral 2007).

In literature, various terms are associated with the combination of mobility services, such as ‘co-modality’ (Skoglund and Karlsson 2012), ‘mobility as a service’ (Callegati et al. 2017), and ‘smart mobility’ (Schulz et al. 2018). In this study, we use the term ‘intermodal’ transportation or mobility (Willing et al. 2017b), defined as “the movement of people involving more than one mode of transportation during a single, seamless journey” (Jones et al. 2000, p. 349). In line with Willing et al. (2017b), we do not equate mode of transportation with type of vehicle.

There is broad consensus that the provision of intermodal mobility is based on service ecosystems (e.g., Lind and Haraldson 2015; Schulz and Überle 2018) comprised of a number of actors, such as mobility providers, government agencies, and customers (Schulz and Überle 2018). For example, a national government can legislatively promote car-sharing parking spaces or lots in public spaces close to bus and train stations (Bundesministerium für Verkehr und digitale Infrastruktur 2017). In addition to the physical connection, the digital connection of mobility services is also important. For instance, public transport companies can implement sensors that provide real-time timetable data drawn on by apps (service platforms) that account for cancellations and delays and adjust the intermodal travel chain as needed. Currently, however, IT support of intermodal mobility is limited with regard to the functional range of these apps (e.g., a lack of integrated ticketing and the only use of static data) (Willing et al. 2017b; Albrecht and Ehmke 2016; Schulz et al. 2018; Schulz and Überle 2018).

The service-dominant (S-D) logic perspective (Vargo and Lusch 2004) has been applied in the analysis of service ecosystems in various domains, such as mobility (Schulz and Überle 2018; Hein et al. 2018; Gilsing et al. 2018), education (Jarvis et al. 2014), travel (Schmidt-Rauch and Schwabe 2014; Prebensen et al. 2013), and healthcare (Nyende 2018; Hardyman et al. 2015), to better understand the value co-creation of their actors. In previous studies (e.g., Hein et al. 2018; Schulz and Überle 2018), taking the S-D logic perspective was usually considered and justified from the point of view of one actor, often customers. For instance, Gilsing et al. (2018, p. 2) argue “that customers increasingly move away from a goods-dominant perspective (e.g. buying a car) but rather look at the value (e.g., the flexibility and ease-of-use) offered by car sharing applications that provide a similar mode of transportation”.

In this study, building additionally on traditional institutional literature, we assume an institutional logic multiplicity among the actors of a service ecosystem: (1) Watson et al. (2012) show that over time actors have adopted *different dominant institutional logics*, and that S-D logic is currently being replaced by sustainability dominant logic focused on reducing the impact on the environment. Because actors change at different speeds, varying dominant institutional logics can be assumed. (2) Grinevich et al. (2019) find that actors use *different combinations of institutional logics* at a given point in time.

Until today, S-D logic literature (Vargo and Lusch 2017; Akaka et al. 2013; Koskela-Huotari et al. 2016) postulates, rather vaguely, that conflicting institutions and institutional arrangements (e.g., rules, norms and beliefs), otherwise known as institutional logics (Lusch and Nambisan 2015), constrain value co-creation of service ecosystem actors. But the role of institutional logics in service ecosystems is not well understood (Vargo and Lusch 2017), among others, the link between institutional logics, and institutional logic multiplicity in particular, and the IT adopted by actors is unclear. This leads to the following research question: *How does institutional logic multiplicity among actors negatively affect the functional range of service platforms in service ecosystems for intermodal mobility?*

In order to better understand this link, which is also under-researched in institutional information systems (IS) research (Busch 2018), we apply activity theory (AT) and its concept of contradictions (Kuutti 1996). We consider intermodal mobility as an activity of people to get from place to place during a single seamless journey using different mobility services, which can be supported by IT, such as a service platform (app). In accordance with the ideas of S-D logic perspective, a number of actors, such as mobility providers and city administrations, are involved in the activity, which are governed by different rules (i.e., institutional logics). We test our theoretical arguments on data collected in four German service ecosystems for intermodal mobility. Our results show that, in particular, the state logic of some actors, which is characterized by the obligation to provide mobility, negatively affect the quality of service platforms.

The remainder of this article is structured as follows. First the theoretical foundation (S-D logic perspective, concept of logic multiplicity, and AT) is outlined. Subsequently, the methodology is described and the results are presented, followed by a discussion of the implications and limitations of the study, as well as opportunities for future research. The article ends with a conclusion.

2 Theoretical Background

2.1 Service-Dominant Logic Perspective

As an overarching theoretical lens, we adopt the service-dominant (S-D) logic perspective. Vargo and Lusch (2004) argue that, in the past, researchers and practitioners viewed economic activities predominantly from a goods-dominant (G-D) logic perspective. According to G-D logic, goods (primarily tangible manufactured products) are the primary unit of exchange and the customers have the passive role of purchasing such goods on the market. For example, automobile manufacturers produce more or less standardized cars, which are sold on the international market. In contrast, according to S-D logic perspective, "people exchange to acquire the benefits of specialized competences (knowledge and skills), or services" (Vargo and Lusch 2004, p. 7).

Evidence of the shift from G-D logic to S-D logic can be seen in the emergence of the sharing economy (e.g., car-, bike-, and ride-sharing). A particular characteristic of S-D logic perspective is that customers play an active role in the creation and provision of services. For example, ride-sharing companies only provide a service platform (app) to enable service-for-service exchange between providers and customers. Similarly, in the case of intermodal mobility, customers can, for instance, provide GPS data from their smartphone which an app can use to adapt the travel chain in the event of a cancellation or delay (Schulz and Überle 2018). Originating in marketing (Vargo and Lusch 2004), the S-D logic perspective has also been used in numerous disciplines, such as service science (e.g., Spohrer and Maglio 2010; Ordanini and Parasuraman 2011), education research (e.g., Jarvis et al. 2014), and IS (Giesbrecht et al. 2017; Lusch and Nambisan 2015; Schmidt-Rauch and Schwabe 2014; Nischak et al. 2017; Brust et al. 2017; etc.).

The S-D logic perspective focuses on three main elements: (1) the service ecosystem, (2) the service platform, and (3) value co-creation (Lusch and Nambisan 2015; Hein et al. 2018). A *service ecosystem* can be defined as "a relatively self-contained, self-adjusting system of mostly loosely coupled social and economic (resource-integrating) actors connected by shared institutional logics and mutual value creation [i.e., value co-creation] through service exchange" (Lusch and Nambisan 2015, p. 161). An exemplary service ecosystem for intermodal mobility is described by Schulz and Überle (2018). Its key actors are mobility providers, such as public transport, bike-sharing, and car-sharing companies, government agencies (e.g., national government, state governments, and city administrations), industry associations, and customers. It is worth noting that actors are embedded in several service ecosystems at the same time (Akaka et al. 2013).

Rules, norms and beliefs represent institutions and institutional arrangements (collections of interrelated institutions) that govern the service-for-service exchange activities of actors within and between service ecosystems (Vargo and Lusch 2017; Scott 2008). A synonym for institutional arrangements is "institutional logics" (Lusch and Nambisan 2015, p. 163; Vargo and Lusch 2017, p. 49). In order to ensure the function of a service ecosystem, actors need shared institutional logics that enable them to develop a shared worldview of their environment (Lusch and Nambisan 2015). If the institutional logics are incompatible, there will be conflicts that constrain service-for-service exchange (Akaka et al. 2013; Koskela-Huotari et al. 2016; Vargo et al. 2015). Overall, research on institutional logics is still in its infancy (Vargo and Lusch 2017). Watson et al. (2012) argue that some actors are replacing S-D logic by sustainability dominant logic. An example are public transport companies introducing electric or hydrogen fuel cell buses to reduce environmentally harmful emissions.

A *service platform* is "a modular structure that consists of tangible and intangible components (resources) and facilitates the interaction of actors and resources (or resource bundles)" (Lusch and Nambisan 2015, p. 162). An example is the Android platform in symbiosis with its apps. Service platforms enable actors to conduct service-for-service exchange more efficiently (Lusch and Nambisan 2015; Hein et al. 2018). Without referring to the S-D logic perspective, Albrecht and Ehmke (2016) and Willing et al. (2017b) identify a limited functional range of apps to support people's intermodal mobility (e.g., a lack of integrated ticketing) caused by an insufficient service-for-service exchange.

Value co-creation refers to resource integration and service exchange among actors (Vargo and Lusch 2017). It is rooted in the assumption "that value is fundamentally derived and determined in use – the integration and application of resources in a specific context – rather than in exchange [G-D logic] – embedded in firm output and captured by price" (Vargo et al. 2008, p. 145). For example, customers determine the value of a car-sharing app by evaluating the provided flexibility and ease-of-use (Gilsing et al. 2018). According to Payne et al. (2008), technical breakthroughs and changes in the industry logic such as those currently taking place in the mobility market provide important opportunities for value co-creation.

2.2 Logic Multiplicity

The S-D logic literature assumes that all actors of a service ecosystem adopt the service logic as their dominant institutional logic. The institutional logics that complement the S-D logic and the possibility that some of the actors of a service ecosystem might have different dominant institutional logics have been neglected in research (Vargo and Lusch 2017). We call this 'logic multiplicity', which can be defined as follows: There is logic multiplicity in a service ecosystem if the actors have multiple, at least in part different, institutional logics. In particular, the dominant institutional logic of the actors can also vary. In contrast to S-D logic literature, traditional institutional literature, whether it focuses on IS, management, or economics (Watson et al. 2012; Grinevich et al. 2019; Prahalad and Bettis 1986; etc.), highlights that actors follow multiple institutional logics, and that the dominant institutional logic can vary among actors. As a result, S-D logic perspective can be enriched by the institutional literature, and thus provide valuable insights into how logic multiplicity can negatively affect value co-creation of actors in a service ecosystem. In the following, we present different typologies, which originate from institutional literature, to capture the varying institutional logics of actors in a service ecosystem for intermodal mobility.

The typologies can be categorized into two perspectives, as illustrated in Table 1. The *static perspective* (e.g., Grinevich et al. 2019; Vickers et al. 2017) is characterized by the assumption that an actor adopts several institutional logics, one of which is dominant. As Watson et al. (2012, p. 3) point out, different dominant institutional logics among actors can be assumed: "in a particular phase of economic development *many* [*but not all*] firms will have adopted the same dominant logic, as implied by Vargo and Lusch (2004)". Previous research shows that a dominant institutional logic can prevent strategic alliances, and also determines the IS needs of actors (Watson et al. 2012; Boivin and Roch 2006).

The *dynamic perspective* (e.g., Joiner and Lusch 2016; Gozman and Currie 2013) shows how societies and civilizations have gone through periods with varying dominant institutional logics. According to Watson et al. (2012), they start from the *survival dominant logic*, in which gathering of food and hunting is in the foreground, up to the *food production dominant logic*, the *goods production dominant logic*, the *customer service dominant logic* (a synonym for S-D logic), and more recently the *sustainability dominant logic*. The latter is not about reactively reducing costs by avoiding waste or minimizing the risks of law suits, but about actively reducing the impact on the environment. A shift to a new dominant institutional logic does not mean that the previously dominant institutional logic is no longer relevant. Within a sector, such as mobility, early shifters can invalidate the value proposition of competitors who rely on the prior dominant institutional logic (Watson et al. 2012). IT can enable or constrain a shift, since the IT developed up to this point reflects the needs of the current dominant institutional logic (Slavova and Karanasios 2018; Watson et al. 2012). For instance, Slavova and Karanasios (2018) show how IT enables the transition of Ghanaian farmers from a *smallholder* to a *value-chain dominant logic*.

The typologies of the static perspective focus on a specific domain (e.g., Vickers et al. 2017; Bunduchi 2017), such as mobility (Grinevich et al. 2019; Schultze and Bhappu 2017) or healthcare (Baroody and Hansen 2012). As a result, the typologies and their institutional logics can only be transferred across contexts to a limited degree. In the following, we present two typologies to capture the institutional logics of actors involved in service ecosystems for intermodal mobility, including government agencies, service platform operators, and mobility providers, such as public transport companies. (1) Grinevich et al. (2019) focus on sharing platform operators (e.g., car-sharing, and car-pooling companies), and (2) Vickers et al. (2017) focus on public sector organizations.

Table 1 Exemplary typologies of (dominant) institutional logics

Static perspective		Dynamic perspective	
Grinevich et al. (2019)	Vickers et al. (2017)	Watson et al. (2012)	Slavova and Karanasios (2018)
Economic logic	State logic	Survival dominant logic	Smallholder dominant logic
Social logic	Market logic	Food production dominant logic	Value-chain dominant logic
Green logic	Civil society logic	Goods production dominant logic	
		Customer service dominant logic	
		Sustainability dominant logic	

According to Grinevich et al. (2019), actors apply economic, social, or green logic, or a combination of them, when engaging with a sharing platform (a synonym for a service platform). In turn, a sharing platform operator must manipulate these institutional logics in order to gain the support of actors. *Economic logic* refers to the convenience and cost advantage that a service platform can provide to customers. In the case of intermodal mobility, a service platform can, for instance, offer integrated ticketing with a price advantage in comparison to individual bookings (Schulz et al. 2018). *Social logic* reflects the ability of a service platform to enable customers to gain social experience, which is feasible with sharing and public transport services. Lastly, *green logic* is characterized by the fact that a service platform can reduce the ecological footprint of mobility and increase its sustainability. For example, a service platform that provides intermodal mobility can contribute to ecological sustainability by reducing the use of private cars. This typology, however, alone is not sufficient because public transport is a public service.

Vickers et al. (2017) typology of institutional logics among providers of health and wellbeing services as a public good is better suited as taxpayer money is also used to maintain the public transport service (*state logic*). Depending on the state or local public transportation philosophy, actors may also be subject to *market logic* and be pressured to provide services effectively and efficiently. In addition, a *civil society logic* is evident in the focus on social goals, such as to meet all actors' needs for social and economic participation, and in the emphasis of the value of shared knowledge.

2.3 Activity Theory

It is obvious that logic multiplicity among actors of a service ecosystem can negatively affect their value co-creation. For instance, the legal obligation of a city administration to reduce air pollution may seem to contradict the economic objectives of a public transport company, such as cost reduction and thus the reluctance to invest in electric or hydrogen fuel cell buses. Similarly, it can be assumed that the choice of IT (a service platform, sensors for the provision of real-time data, etc.) adopted by the actors of a service ecosystem also depends on their institutional logics, and that logic multiplicity may have a negative impact. We apply activity theory (AT) (Leont'ev 1978; Vygotsky 1978; Engeström 1987) to shed light on the link between institutional logics and technology (IT), which has been neglected in IS literature (Busch 2018). By using the activity system as unit of analysis, we show how a logic multiplicity can introduce contradictions which negatively influence the functional range of a service platform aiming to support intermodal mobility (activity). In other words, we use AT to bridge the gap between a micro-level understanding of practice and a macro-level understanding of IT-enabled value co-creation in service ecosystems (Slavova and Karanasios 2018).

AT can be used to investigate the activity of a *subject*, which can be an individual or a collective, such as a cross-functional team (Crawford and Hasan 2006), a department (Weeger and Haase 2016), or an organization (Karlsson and Wistrand 2006; Allen et al. 2013; Jarzabkowski 2003). AT has been applied in many disciplines, including management sciences (e.g., Jarzabkowski 2003), organizational sciences (e.g., Blackler et al. 2000), and IS (Allen et al. 2013; Hasan et al. 2016; Karanasios and Allen 2013, 2014; Weeger and Haase 2016; Slavova and Karanasios 2018; etc.). The unit of analysis is always a "collective, artifact-mediated and object-oriented activity system" (Engeström 2001, p. 136). Figure 1 illustrates the elements of a generic activity system and how these elements are defined in the current study.

An activity of a *subject*, such as getting from one place to another, is always mediated by one or more *instruments*, which enables it to transform an *object* and to achieve an *outcome* more efficiently (Allen et al. 2013; Blackler et al. 2000). An individual conducting intermodal mobility can, for instance, use a service platform (app) to purchase a combined ticket for bus and subsequent train transport. Without this instrument, she would have to purchase the tickets separately, which requires greater cognitive effort and more time. This relationship is shown in the top triangle in Fig. 1. In an activity system there are further elements (rules, community, and division of labor) which moderate the relationship between the subject and the object. The previous example illustrates that a collective *community* with a *division of labor* evolves around an

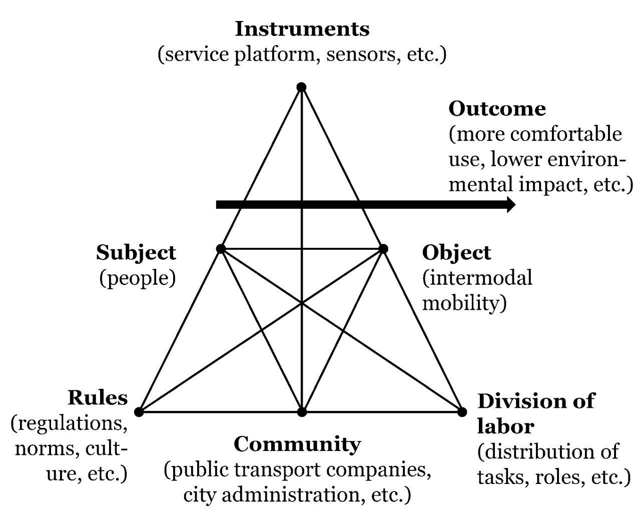

Fig. 1 Generic activity system (Engeström 2001) and application to current study (in parentheses)

object (Engeström 2001). In the present case, the community includes a number of actors, such a bus and a train company that provide the transport service, and the city administration, which is responsible, for example, for road construction and maintenance. Each actor has multiple points of views, traditions, and interests, leading to multivoicedness (Engeström 2001). For instance, a city administration may prioritize low ticket prices for public transport and restrictive parking regulations in order to encourage public transportation and reduce private car use, while private and perhaps public transport companies want to generate the largest possible revenues. As a result, a number of *rules* are needed to govern the different actors and their collaboration. The positions of the actors, their histories, and the history of the activity system are "engraved in its artifacts, rules and conventions" (Engeström 2001, p. 136).

Referring to the S-D logic perspective, the institutional logics (e.g., rules, norms and beliefs) of each actor, including their dominant institutional logic, are captured by the rules element and also reflected in the instruments. Logic multiplicity in a service ecosystem can negatively affect the functional range of a service platform, reflected by contradictions in the activity system. According to Kuutti (1996, p. 34), contradictions represent "a misfit within elements [of an activity system], between them, between different activities, or between different developmental phases of a single activity". However, contradictions are only indirectly revealed through "problems, ruptures, breakdowns, and clashes" (Kuutti 1996, p. 34). Due to their nature, they are in opposition to the motive of the activity system and the goals actors are individually or collectively striving to achieve (Allen et al. 2013).

3 Methodology

3.1 Research Context

We consider Germany a suitable focus for our study of service ecosystems for intermodal mobility for several reasons. First, intermodal mobility is increasingly relevant in Germany. Just recently, courts have banned diesel cars from driving in some areas of several cities to reduce air pollution (ADAC 2019). Such government interventions heighten the need for intermodal mobility. In addition, many cities suffer from congestion. For example, in Berlin, car drivers waited on average 154 h in traffic in 2018, the highest average in Germany (INRIX 2019). This further drives citizens' desire for alternatives to private car use. Second, a shift in mobility behaviour towards intermodal mobility is expected in Germany. For instance, among 18–24 year olds living in Germany the importance of private car ownership and the emotional attachment to the car is decreasing (Bratzel 2018). Third, Germany is well situated to implement intermodal mobility due to its extensive public transport infrastructure, public pressure to realize intermodal mobility, and supportive legal conditions (Marx et al. 2015; Willing et al. 2017b). For example, German government agencies subsidize public transport company net losses every year, which totaled 3 billion euros in 2016 (Verband Deutscher Verkehrsunternehmen 2018).

3.2 Data Collection and Analysis

To answer our research question, we analyzed qualitative data collected from several actors embedded in different German service ecosystems for intermodal mobility. As outlined in literature, such an approach is suitable to understand new and complex phenomena (Yin 2014; Eisenhardt 1989) and is thus well-suited for the analysis of the logic multiplicity of actors and its impact on the functional range of service platforms. In addition, it is especially useful for generating practice-relevant knowledge (Gibbert et al. 2008).

To identify suitable service ecosystems and actors, we selected the German federal state of Baden-Württemberg to ensure that the examined service ecosystems are anchored in the same state-level legal environment. We then selected four cities with at least 100,000 inhabitants (denoted as city 1 to 4) (Statistisches Bundesamt 2011) because big cities are more immediately confronted with the problems caused by the predominant use of private cars, and often have a more extensive infrastructure for intermodal mobility (e.g., bike- and car-sharing services) than smaller cities and towns.

In line with Yin (2014), we used interviews to collect primary data. Based on our theoretical foundation, we developed slightly different semi-structured interview guidelines for the actors, such as government agencies and public transport companies (Table 2). Semi-structured interviews offer us a high degree of flexibility and give us the opportunity to respond to interesting issues that become clear during the interview (Flick 2009). When designing the guidelines and conducting the interviews, we ensured that the questions did not evoke socially desirable answers. Whenever possible, our questions did not focus directly on the institutional logics (e.g., green logic) under examination. Accordingly, we asked relatively broad questions, such as 'What should future mobility look like?', 'What steps are necessary to put this future mobility into practice?', and 'What tasks does this imply for your organization?'. In addition, the guidelines contained more detailed questions on the activity system elements, in particular on the (IT) instruments (e.g., on service

Table 2 Overview of the interviewees conducted

Actor	City 1	City 2	City 3	City 4
State ministry	SM			
State public transit authority	SPTA			
Region administration	RA1	n.a.	n.a.	n.a.
City administration	CA1	CA2	CA3	CA4
Transport and tariff association	TTA1	TTA2	TTA3	TTA4
Public transport company	–	PTC2	PTC3	–
Car park operator	–	CPO2	–	–
Smart integrator (industry association)	SIIA	n.a.	SIIA	SIIA
Smart integrator (private)	SIP	n.a.	SIP	SIP

platforms and sensors for the provision of real-time timetable data). Exemplary questions are: ‘Why do you (not) cooperate with one or more smart integrators?’ and ‘What value can smart integrators provide for customers?’. This interview design helps mitigate potential bias due to socially desirable answers of interviewees.

We interviewed “numerous and highly knowledgeable informants” (Eisenhardt and Graebner 2007, p. 28), such as managing directors, department heads, and project managers, to further mitigate potential bias, taking a snowball sampling approach (e.g., Su 2013) to identify experts from additional organizations involved in the service ecosystem. In total, sixteen actors agreed to be interviewed. We also triangulated the data (Flick 2009; Miles et al. 2014) with information provided on actors’ websites.

Transport and tariff associations are alliances of government agencies (e.g., state government, city administrations) and public transport companies, which are tasked with organizing and providing public transport in a restricted local geographic area (Reinhardt 2012). They offer a range of mobility services, such as bus, subway, and tram transport, but also potentially sharing services such as bike-sharing. *Car park operators* are included in the sample because they manage the infrastructure required to combine private car driving and alternative mobility services. Emerging *smart integrators* are companies that use IT to support intermodal mobility, for example by developing service platforms (apps) that automatically adapt intermodal travel chains in case of a delay (Schulz et al. 2018). The interviews were conducted between October 2018 and January 2019, lasting on average 38 min. Afterwards, the recordings were transcribed.

For data analysis, we used the NVivo 12 software program. One of the researchers coded the data. Subsequently, in order to ensure reliability, the other researchers cross-checked the results (e.g., Weeger and Ott-Schwenk 2017). The coding process consisted of two rounds of analysis and followed the approach proposed by Strauss and Corbin (1998). In the first round, the data was coded according to the different elements of the activity system (rules, instruments, etc.). In the second round, we further categorized the codes of the rules and instruments element. For instance, the codes belonging to the rules were assigned to different institutional logics. This approach revealed problems (i.e., contradictions) affecting the functional range of service platforms that arise from logic multiplicity. Next, we compared the coding for the actors within and across the service ecosystems for similarities and differences. During the interpretation of the codes, we followed the recommendation of Miles et al. (2014) and discussed the emerging results in the research team.

4 Results

4.1 Logic Multiplicity in Service Ecosystems for Intermodal Mobility

Our analysis confirms that there is a logic multiplicity among the actors of the service ecosystems for intermodal mobility and, in particular, that service logic is not the dominant institutional logic for all actors, as postulated in S-D logic literature. By drawing on AT, we illustrate that the institutional logics of each actor, which are assigned to the rules element of the activity system, are directly linked to the elements denoted as subject, object, and community, as illustrated by the shaded diamond in Fig. 2. In other words, the diamond reflects “how actors [subject or community] are influenced by and seek to influence institutional logics” (Busch 2018, p. 1) in the context of intermodal mobility. This link between the service ecosystem actors and their institutional logics, as highlighted on the right side of Fig. 2, has been the focus of previous institutional literature from the IS field.

In the case of logic multiplicity, there is a risk of conflicting institutional logics. For example, from the perspective of a city administration, public transport represents a public good (i.e., state logic) and a high service frequency can contribute to the attractiveness of the city. In contrast, a private public transport company aims to

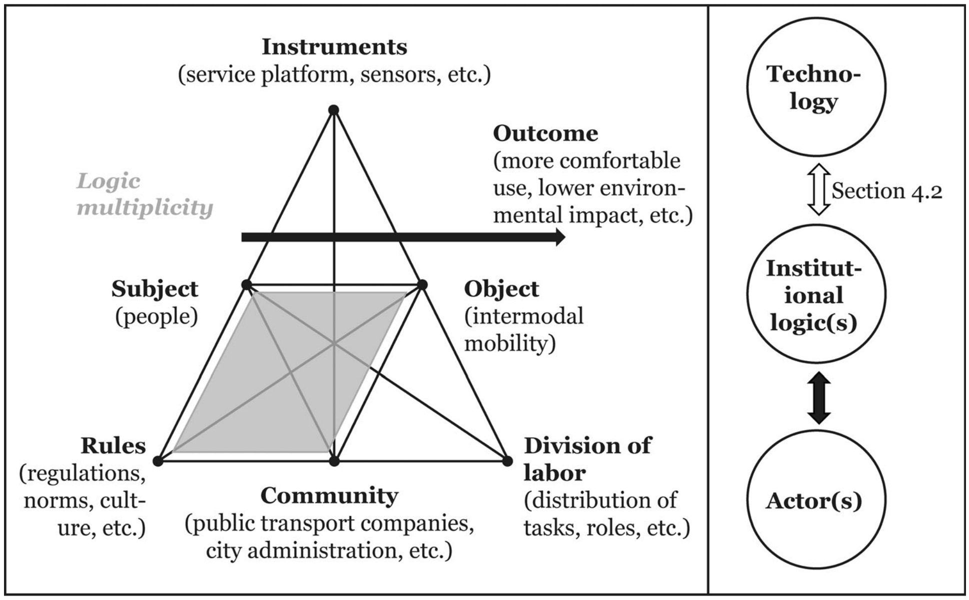

Fig. 2 Elements of the activity system affected by logic multiplicity

maximize its profits and would therefore prefer to closely align route frequency to passenger volume. Which of the institutional logics prevail therefore has an impact on the intermodal mobility of the subject and the related outcome (e.g., short vs long travel time). The institutional logics of the actors also influence which instruments are used in the service ecosystem (activity system). Accordingly, conflicting institutional logics due to logic multiplicity can lead to contradictions in the instruments element, which in turn negatively impact the object and the outcome. The link between institutional logics and technology (IT) has so far been largely neglected in IS research and is discussed in Sect. 4.2.

On the basis of the interviews, we checked whether the actors follow the institutional logics described in the theoretical background. Our results reveal that most actors have adopted *service logic*. The representatives (e.g., SPTA, TTA1, PTC3) emphasize that a single mobility service, such as station- and timetable-based public transport, which adheres closely to G-D logic, has significant limitations. They expect that value co-creation in a service ecosystem and the provision of intermodal mobility can better satisfy customer needs. This can be seen from the following exemplary quotations:

> I think you have to get there [intermodal mobility], because you have to cover the last mile (PTC2).

> Future mobility should be intermodal. This means that it must be possible for me to decide at the starting point how I can get to my destination most quickly and comfortably. I am firmly convinced that not only the car will be used, but that citizens will switch to other forms of mobility during a trip (CA2).

The representative of TTA4 has a particularly pronounced service logic, questioning the current *object* of the activity. According to his vision, additional service providers should participate in the service ecosystem:

> To get away from the thought ‘a ride is booked’, but instead to say, ‘an activity is booked’. The aim of the trip is in the focus. For example, I book a cinema ticket and simultaneously transport for the way there and the way back (TTA4).

Nevertheless, it cannot be assumed that an institutional logic always applies to an actor. As written above, the representative of CA2 has adopted service logic. However, it is bound to the presence of specific actors in the service ecosystem (*community*):

> In Stuttgart, for example, Car2Go only works in the city centre because there are a lot of people, a lot of fluctuation, a lot of short distances that are covered by private car. In my eyes, where it makes sense to establish car-sharing, namely in the outskirts, and then connect it to public transport, such as trams and subways (which run every 5 to 10 min), Car2Go has now terminated its operations. That is tragic because it prevents modern mobility (CA2).

But not all actors have adopted service logic, as is illustrated by the following statements by CPO2. The reason for this is that a need for intermodal mobility is not appreciated by all customer segments (*subject*):

> We haven’t thought much about it yet because most of our customers haven’t highlighted this need. Maybe we’re a bit conservative about that, too (CPO2).

> I drive my car to the train station and switch to the train. But I can also get to the train station by bus or tram. But would you like to switch as a businessman? I don't know (CPO2).

Instead, a rather G-D logic is adopted, emphasizing the importance of private cars:

> The goal of Porsche AG and Volkswagen AG is to sell cars. The goal of car park operators is to provide parking spaces. If there are fewer cars in the future, everyone has a problem. This is really in the near, or hopefully not so near future, a question of existence (CPO2).

These explanations show how the institutional logics of actors are influenced by the activity system elements of the shaded diamond (subject, object, and community). In line with the assumption of logic multiplicity, the actors have adopted several and different institutional logics. One of these is *civil society logic*, which focuses on social goals, such as social and economic participation, and on the implementation of knowledge sharing. The social and economic participation (e.g., undertaking leisure activities, pursuing a job) of specific groups of people, such as the elderly, people with low incomes, or rural dwellers, is ensured by taking into account their special needs with regard to mobility services:

> There is often the claim: "'I want a sales person'. (…). 'I want to be able to ask someone'. (…). These are people who either don't have internet access or can't operate the smartphone" (SPTA).

> The developments in the field of ride-pooling, ride-sharing, all the shuttle services, (…) also have a positive effect. This is a very good way to better connect rural areas (TTA4).

In addition, civil society logic highlights the need to share knowledge. The exchange of information relating to the transport service, such as line schedules and (real-time) timetable data, is supported by most of the representatives. However, there are often (privacy) concerns relating to the sharing of customer data (e.g., PTC3; TTA4):

> They can access our data. We're not a government agency, but we are a state institution. Our aim is not to make a lot of money, but to provide information so that others can use it (SPTA).

> It is presumed, as in the case of Google, that they are very commercialized and market-research oriented. This means having an interest in selling data to other private companies. This is of course something that neither a transport and tariff association nor a government agency, such as a city administration, can support (CA3).

Many actors also support *economic logic* and attempt attracting more customers through price discounts for a mobility service. The representative of TTA3, for instance, explains that a new tariff was introduced which takes into account the beeline distance between the start and end location:

> By the way, the electronic tariff for example (i.e., the beeline distance tariff), is for the vast majority of users cheaper than other tariffs. So, in this respect, it is an incentive (TTA3).

Taking account of the current public debate on ecological sustainability and the recent driving bans on diesel cars in certain areas in some German cities, it is not surprising that the behaviour of the actors is influenced by *green logic*. For the smart integrators, this could be one way to legitimize their role:

> Secondly, an ecological advantage is achieved because we can encourage citizens to switch from their private car to other mobility offerings, such as public transport. Public transport is mostly available, and of course it is our aim to encourage citizens to use this offering where it is available. And if public transport is not available, we intelligently complement mobility with bicycles, car-sharing, shuttle service, taxi service, etc. (…). This enables us to reduce emissions extremely. That is one of our goals. This is the core benefit (SIP).

The green logic also represents the dominant institutional logic for the representative of CA4, who state:

> The core topic of future mobility is sustainability in mobility – sustainability and urban compatibility. A focus of the traffic development plan is also on the environmental alliance (i.e., cycling, walking, and public transport). This should be strengthened, and its share be further increased at the expense of motorized private transport (CA4).

As this representative explains, the provision of intermodal mobility (service logic) is only one way to achieve this goal. Other approaches focus on the reduction of traffic volume by improving local infrastructure and thus shortening distances to meet needs (go shopping, get to work, etc.), as well as on regulatory actions, such as speed limits. Table 3 provides an overview of the actors' institutional logics. In some cases, based on the interview data, the dominant (*), or at least a non-dominant institutional logic (°), could be identified. For example, "the core topic of future mobility is sustainability in mobility" (CA4) versus

Table 3 Logic multiplicity among the actors of the service ecosystems for intermodal mobility

Actor	City 1	City 2	City 3	City 4
State ministry (SM)	Civil society logic			
	Economic logic			
	Green logic			
	Service logic*			
	State logic			
State public transit authority (SPTA)	Civil society logic			
	Economic logic			
	Service logic			
	State logic*			
Region administration (RA)	Civil society logic			
	Green logic°			
	Service logic			
	State logic			
City administration (CA)	Civil society logic	Civil society logic	Civil society logic	–
	Economic logic	–	–	–
	Green logic*	Green logic°	Green logic	Green logic*
	–	–	Market logic	–
	Service logic	Service logic	Service logic	Service logic
	State logic	State logic	State logic	State logic
Transport and tariff association (TTA)	Civil society logic	–	Civil society logic	Civil society logic
	Economic logic	Economic logic	Economic logic	Economic logic
	Green logic	–	Green logic	Green logic
	Market logic°	–	–	Market logic°
	Service logic	Service logic	Service logic	Service logic
	State logic	–	–	State logic
Public transport company (PTC)		–	Civil society logic	
		–	Economic logic	
		–	Green logic°	
		Market logic	Market logic	
		Service logic	Service logic	
Car park operator (CPO)		Civil society logic		
		Goods logic°		
		Market logic		
		State logic		
Smart integrator – Industry association (SIIA)	Civil society logic		Civil society logic	Civil society logic
	Service logic		Service logic	Service logic
Smart integrator – Private (SIP)	Economic logic		Economic logic	Economic logic
	Green logic*		Green logic*	Green logic*
	Market logic		Market logic	Market logic
	Service logic		Service logic	Service logic

"sustainability is certainly one of the goals" (CA2).The representatives (CA3, PTC3, TTA1, etc.) also followed *market logic*, which is characterized by the goal of providing a mobility service more effectively and efficiently. This puts transport services and distribution in focus:

We need "to make buses more efficient. Bus transport is often like that – you may know it – at 9 pm mostly only hot air is transported. Or, there are one or two people sitting in the bus and that's it. If you make bus transport more flexible, independent of timetables and bus stops, there is a greater chance to

> achieve a higher occupancy rate and to save costs" (TTA4).

> Of course we try to reduce the number of ticketing machines from an economic point of view (TTA4).

Lastly, the behaviour of some actors is influenced by *state logic*, according to which a mobility service represents a public good:

> Prices cannot always be calculated to cover costs. This is similar to most swimming pools and libraries. Public transport is basically a loss-making system, and therefore a public service obligation. Of course, there are transport lines and means of transport that generate profits, that is clear. But there are also others that have to be subsidised in order to maintain the offer. Public transport companies have usually a self-coverage ratio between 60 and 90 per cent and the difference is subsidised by policy (TTA1, see also, e.g., CA2, SM).

Further characteristics of the state logic are the execution of tenders (RA1, SM, SPTA, etc.) and the obligation to approve tariffs (e.g., TTA1).

4.2 Logic Multiplicity and Its Negative Effect on the Functional Range of Service Platforms

By drawing on AT, we can also better understand the link between institutional logics and technology, which is underexplored in the IS literature. We show that a logic multiplicity among the actors of a service ecosystem, as evidenced in Sect. 4.1, can lead to contradictions affecting the instruments element, such as stifling widespread use of sensors that generate real-time timetable data. As a result, the functional range of a service platform is limited, which in turn leads to inconvenient intermodal mobility (e.g., no real-time updates are provided in the case of a delay). The link between institutional logics and technology is graphically illustrated in Fig. 3. A logic multiplicity among the actors of a service ecosystem concerns the activity system elements in the light grey diamond. Conflicting institutional logics induce contradictions into the light grey diamond, which are transferred to the dark grey diamond, and are revealed as problems and clashes in the instruments element.

4.2.1 Private Service Platforms

4.2.1.1 Service Logic Versus State and Civil Society Logic Among the negative results of contradictions resulting from logic multiplicity of a single actor are the lack of a means to book and pay for tickets with one click (TTA4) and weak recommendations for intermodal mobility due to restricted access to big data analytics based on distributed data (PTC3). Taking the service logic perspective, the current situation is unsatisfactory for customers, as highlighted by the following exemplary quotation:

> The advantage of all intermediaries for the customer is that the whole offer is provided. With regard to Moovel, I say: Yes, it can be booked from a single source. However, in the case of Moovel there is a difference. If I want to book, for example, a Stadtmobil car via the Moovel platform, I still have to be a Stadtmobil customer. Thus, I always have several customer accounts. In my opinion, this has to be changed in order to make the offer more permeable, transparent, and attractive (TTA4).

The state (TTA4) and civil society logic (PTC3, TTA4) of the actors, however, prevent a better technical solution. The reason for this is that independence from private smart integrators (e.g., by data sovereignty) is considered necessary for achieving the goals associated with these institutional logics:

> It is extremely important for us – and I also think for the passengers – that the transport and tariff associations and the public transport companies retain sovereignty over the platform and the data (the distribution channels) simply for the reason of maintaining direct access to the customer and not becoming dependent on these intermediaries. (…). As a commissioning authority for public transport, we are a transport and tariff association that consists of government agencies (we are thus a public authority), we also have a certain obligation to provide mobility not only where demand is high, but also in remote areas that are not as profitable. Therefore, we need to be able to exert influence. If we can design a platform, we can also determine the offer (TTA4).

> If the customer uses mobility services offered by Moovel [the mobility services provided by parent company, Daimler AG] in addition to purchasing our tickets, then Moovel is also entitled to own the customer data. (…). But, in general, customer data is the property of the transport company (i.e., of us). Moovel can't work with this data (PTC3).

In order to solve this contradiction, the TTA4 is working on its own service platform and the construction of stations where citizens can choose between different mobility services.

4.2.1.2 Service Logic Versus Green Logic The analysis of logic multiplicity also provides insights into why a

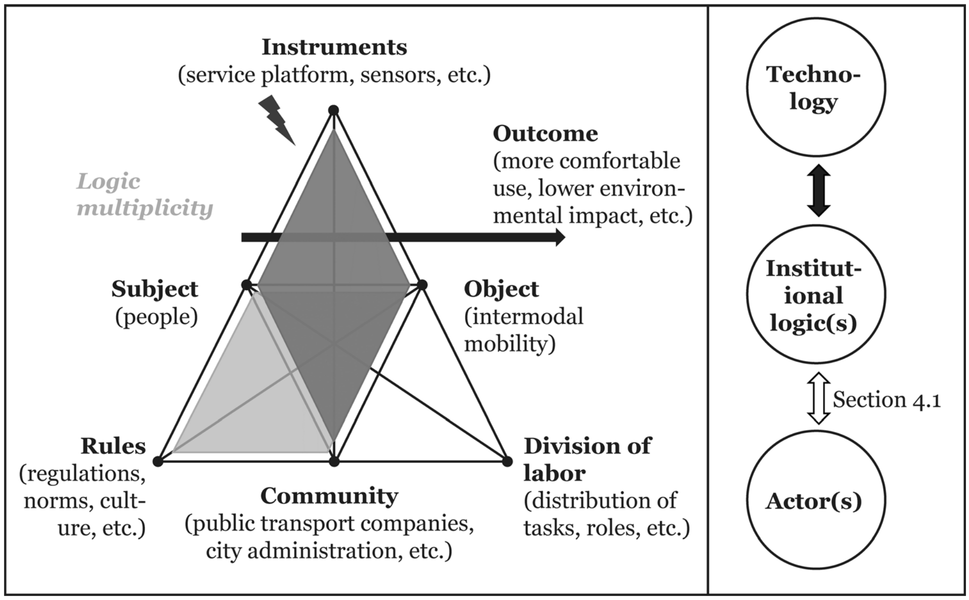

Fig. 3 Logic multiplicity and its negative effect on the functional range of service platforms

service-for-service exchange with private smart integrators is not endorsed, as in the case of CA2 ("on part of the administration, we would not recommend this"). One reason is the lack of willingness to exchange data in terms of civil society logic. Another reason is the contradictory effect of the green logic:

> In areas where actual alternatives are available, because the bus runs every five minutes from A to B in [name of the city], I don't need another product [such as Moovel] that ultimately only clogs the streets [e.g., with car-sharing cars] (CA2).

4.2.1.3 Civil Society Logic Versus Market Logic The civil society logic prevents actors (e.g., PTC3, TTA1) from becoming more effective and efficient through the use of (private) service platforms according to the market logic, which might encourage a more extensive service-for-service exchange:

> We need the ticketing machines. Policy precludes expecting everyone to own a smartphone. That is actually the main reason. The ticket machines have to be serviced, staff has to drive around and clean them. That is what makes the ticketing machines more expensive (TTA4).

The previous results show the negative effects of contradictions due to logic multiplicity of one actor on the functional range of a service platform of private smart integrators. The following illustrates the negative effects of contradictions caused by logic multiplicity between actors on the functional range of service platforms in general.

4.2.2 Service Platforms in General

4.2.2.1 Service Logic Versus State and Civil Society Logic A result of contradictions caused by the logic multiplicity between two actors is the limited focus of a service platform on a city, or on a local geographical area. Thus, the actual needs of citizens, for instance of commuters, as postulated by the service logic, are not sufficiently taken into account:

> This is definitively an issue we will look at or have to look at. Because the customer/user needs such solutions. But as I said, there is a difference whether I do this between regions or in a city. It also depends on who the public transport operator is. In a city such as Stuttgart, for example, there is the Stuttgarter Straßenbahnen AG and the region is operated by the Verkehrs- und Tarifverbund Stuttgart (VVS). If it becomes supra-regional, Ulm has its own municipal public transport company and there will be also something like the VVS for the region of Ulm. They all have different fare models and timetables and that makes integration difficult (SIIA).

A reason for this is the adoption of state logic through a number of actors (CA2, RA1, SPTA, etc.), which is bound to a smaller geographical area: For instance, "the city is the commissioning authority" (CA3). In addition to high complexity, which occurs from the civil society logic (e.g., CA3), and the goal of ensuring the social and economic participation of all citizens: "There are tickets for students and for pupils. We have a ticket for the working population. So there are tickets for different groups of people" (PTC3).

In order to facilitate intermodal mobility between different local geographical areas, for example through an expanded geographical focus of service platforms, it was recently decided to introduce a tariff which enables the combination of long-distance train transport and local public transport at the start and destination point (SM, SPTA, etc.). Expressing a service logic, the representative of SM stated that its organisation intends to allow the distribution of the tariff to service platforms as well. However, the industry association does not want companies other than its members to be allowed to sell the tariff. A means of exerting pressure to enforce this claim is the industry standard for electronic tickets, which is coordinated by the industry association. A corresponding certification is required to be able to sell this tariff ticket:

> At the time, we opted for the industry standard [for electronic tickets], i.e., the standard of [name of the industry association]. This is now an obstacle to the competitive tendering of the distribution channel, which leads to cars and no tickets being sold. Of course you don't want that (SM).

The service and state logic, as revealed by the representative of SM, which would enable federal state-wide electronic ticketing by service platforms, are undermined by lacking support from the industry association due to the state logic perceived as valid up to this point in time. According to this, only its members are allowed to sell tickets. This is also evident from the quotation of the representative of SIIA, who is working on the implementation of a service platform for the industry association:

> Moovel is a sales intermediary who wants to sell the products of our members. This is exactly what we do. That is why I have to say we don't have too much interest in working together (SIIA).

A better (digital) combination of mobility services through service platforms by providing, for example, real-time timetable data and electronic tickets, is also prevented by the state logic of several other actors (e.g., SPTA), which includes the establishment of (price) competition through tenders. The price competition restricts the potential service logic of public transport companies:

> At the moment, the state of Baden-Württemberg is strongly focusing on competition. I believe that this more or less completely prevents [digital] connection [of mobility services], as it creates very strong competition among all public transport companies. I believe that it is difficult, in particular, if the state more or less enters a price competition, like today, and does not focus on quality (PTC2).

4.2.2.2 Service Logic Versus Market Logic On the other hand, the representative of SPTA questions the actual existence of service logic in the case of public transport companies. According to his experience, they provide the contractually specified mobility service with the greatest possible efficiency, passing on costs related to better digital connectivity:

> If we request something about the contract, about the tender, we also bear the full costs. (…). When I say, 'you have to introduce mobile ticketing', the public transport companies estimate the costs and it has to be paid for. Everything I prescribe or wish for will have a price tag (SPTA).

5 Discussion

5.1 Implications for Theory

Our study provides important implications for theory. First, our results highlight the need for researchers to exercise greater caution when taking the S-D logic perspective, which applies to numerous studies in various disciplines (e.g., Ordanini and Parasuraman 2011; Jarvis et al. 2014; Giesbrecht et al. 2017; Schmidt-Rauch and Schwabe 2014). At present, researchers rely on a simplified but in some cases obviously wrong assumption that all actors in a service ecosystem adopt service logic as their dominant institutional logic. Researchers often did not justify this assumption, or only by discussing the advantages that arise from adopting the S-D logic perspective for an exemplary actor (Hein et al. 2018; Schulz and Überle 2018; etc.). This actor is often the customer, whose needs can be better satisfied by actors working together in a service ecosystem in order to provide service, such as intermodal mobility. Logic multiplicity, which is defined as the adoption of multiple, partly different, institutional logics, and possibly even different dominant institutional logics through actors and resulting problems, however, has not yet been considered. S-D logic literature only highlights the importance of shared institutional logics for the functioning of service ecosystems (e.g., Lusch and Nambisan 2015; Vargo and Lusch 2017) and the negative consequences of the lack of shared institutional logics on value co-creation (Akaka et al. 2013; Koskela-Huotari et al. 2016; Vargo et al. 2015). Thus, by providing evidence of logic multiplicity among actors in service ecosystems, we contribute to a stronger theoretical foundation and better application of the S-D logic perspective.

Second, based on the need to capture the logic multiplicity in service ecosystems for intermodal mobility, we draw on traditional institutional literature (e.g., Grinevich et al. 2019; Slavova and Karanasios 2018; Watson et al. 2012) to identify institutional logics of actors. Our review shows that typologies take either a static or a dynamic perspective. Adopting a static perspective, it is assumed that an actor follows several institutional logics at a given point in time, one of which is its dominant institutional logic. We have adapted the typologies of Grinevich et al. (2019) and of Vickers et al. (2017), which refer to sharing platform operators and providers of health and wellbeing services, respectively. Our interviews underscore the relevance of these institutional logics in the context of intermodal mobility. Only the social logic, which is, according to Grinevich et al. (2019), characterized, amongst others, by a focus on enabling customers to have new socialising experiences, did not play a significant role for the interviewees. One reason for this might be that mobility services, such as public transport and car-sharing, are usually provided by companies, and not, as in the case of Airbnb or Couchsurfing, by private people. In contrast, the dynamic perspective deals with a shift of the dominant institutional logic of an actor over time (Slavova and Karanasios 2018; Joiner and Lusch 2016; Gozman and Currie 2013; etc.). A different transition speed of the actors would thus contribute to logic multiplicity in service ecosystems, which supports our theoretical argumentation. Our empirical results confirm the logic multiplicity among actors of service ecosystems for intermodal mobility. Thus, our work provides a good basis for future research on this topic.

Finally, we contribute to a better understanding of the link between institutional logics and technology (IT), which has been largely neglected in IS literature (Busch 2018). In our eyes, AT and its concept of contradictions (Leont'ev 1978; Vygotsky 1978; Engeström 1987) are a suitable theoretical foundation for revealing the negative effects of logic multiplicity on the functional range of service platforms. Rather than building theory per se, we gain knowledge about the link by conceptualising intermodal mobility as a collective activity of service ecosystem actors. When examining the activity, the activity system constitutes the unit of analysis (Engeström 2001). In particular, its graphic representation illustrates how a logic multiplicity can induce contradictions into the activity system that negatively affect the functional range. Our results show that there are two types of contradictions. The first is induced by logic multiplicity in one actor, and the second is caused by logic multiplicity between two actors. By focusing on the entire activity system, we can also gain insights into how its object (intermodal mobility), and thus IT-enabled value co-creation, is negatively influenced by these contradictions.

5.2 Implications for Practice and Policy

Our study has important implications for practice and policy. Initially, we have identified the institutional logics of actors embedded in four German service ecosystems for intermodal mobility. In the run-up to this study, there were some indications that changes had taken place in the institutional logics of the actors. An expectation is that the green logic is more important now than in the past due to increased global awareness of the importance of environmental sustainability. One indication are the court rulings banning diesel cars from some areas of several German cities in order to reduce air pollution (ADAC 2019). Knowledge about the institutional logics of actors helps practitioners to better understand the contradictions leading to inadequate IT support of intermodal mobility (e.g., Albrecht and Ehmke 2016; Schulz et al. 2018; Schulz and Überle 2018). As a result, the private car accounted for a high proportion of total mobility, resulting in traffic jams (INRIX 2019), lack of parking space (Giuffrè et al. 2012), as well as air and noise pollution (Barth and Boriboonsomsin 2008; Willing et al. 2017a, b). Our results show that there is a logic multiplicity among the actors within and between the service ecosystems. However, green logic is the dominant institutional logic for only three actors (CA1, CA4 and SIP). In the other cases, green logic is not dominant (e.g., CA2, PTC3, and RA1), or it could not be observed. Given the urgency of addressing the challenges of environmental sustainability, this can be understood as call to actors to adapt their institutional logics. In contrast, almost all actors have adopted the service logic by confirming the necessity to participate in service ecosystems to better meet the actual needs of citizens through intermodal mobility.

Second, we have identified a logic multiplicity, which induces contradictions into the activity system (Kuutti 1996; Allen et al. 2013) that negatively affect the functional range of service platforms. We find, for example, that the state logic contradicts the service logic of the representative of TTA4. According to the former, there is an obligation to provide public transport in non-profitable areas as well. As a result, the actor attaches great importance to direct customer contact and data sovereignty in order to implement its own service platform. In turn, a private smart integrator (SIP) cannot offer convenient intermodal mobility through one-click booking and payment if several customer accounts are required to ensure data sovereignty. A further limitation associated with distribution of customer mobility data among actors is limited big data analytics, which leads to lower quality intermodal mobility recommendations to customers and weaker insights into the future design of mobility services. Against this background, the question arises whether it is still necessary to impose on actors the obligation to provide mobility. Technological progress enables actors to offer new mobility services, such as on-demand services, for which previously unprofitable areas are attractive. Our results also illustrate that the civil society logic of actors (e.g., PTC3) contradicts the service logic of smart integrators. For instance, the desire to offer all citizens affordable mobility through specific tickets, as well as an array of distribution channels to enable, for instance, elderly people to buy tickets without smartphones, increases the level of technical complexity. One consequence is the spatially limited focus of service platforms. In order to support citizens through IT, this broad range of service should be reduced. In summary, we contribute to the understanding of practitioners with regard to logic multiplicity that negatively affect the functional range of service platforms, which helps them in adopting awareness for their actions.

5.3 Limitations and Future Research

Our study has some limitations which should be addressed by future research. First, it focuses on service ecosystems for intermodal mobility in a single German federal state. Future research should focus on additional German federal states and on countries with different legal frameworks to confirm the transferability of the results. In addition, this study only indirectly takes into account sharing companies, such as bike-sharing and car-sharing, which offer their mobility services in cooperation with transport and tariff associations. Future research should also consider mobility services provided independently of transport and tariff associations.

Given the sparse knowledge about the institutional logics of actors in service ecosystems for intermodal mobility, we adapted existing typologies (Grinevich et al. 2019; Vickers et al. 2017). Following Grinevich et al.'s (2019) approach, we conducted semi-structured interviews to identify actors' institutional logics and determine whether an institutional logic is dominant or complementary. This approach has two limitations. First, we only interviewed single representatives of each organization, which has a risk of bias. In order to mitigate potential bias, we selected experts as informants (Eisenhardt and Graebner 2007). Second, our interview data did not always reveal the dominant institutional logic of actors. Hence, in order to determine the importance of the contradictions induced by logic multiplicity, quantitative analysis of logic multiplicity in the service ecosystems for intermodal mobility is needed. Interesting insights into the effect of institutional logics patterns on IT implementation might be provided by qualitative comparative analysis (Rihoux and Ragin 2009). In addition, long-term studies could reveal the factors triggering shifts in institutional logics and how IT is affected by such shifts.

6 Conclusion

In this study, we analyze logic multiplicity among actors in service ecosystems for intermodal mobility and its influence on the functional range of service platforms. Our work is novel in that it questions the assumption of S-D logic literature that the service logic is the dominant institutional logic of all actors, as well as challenges the common practice of not taking complementary institutional logics into account. In addition, we contribute to the understanding of the link between institutional logics and IT, which has been neglected so far. The results of a German qualitative study show that, in particular, the state logic of some actors, which is characterized by the obligation to provide mobility, impairs the quality of service platforms in supporting citizens in intermodal mobility.

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References

ADAC (2019) Dieselfahrverbot: Alle Fragen und Antworten. https://www.adac.de/rund-ums-fahrzeug/abgas-diesel-fahrverbote/fahrverbote/dieselfahrverbot-faq/. Accessed 29 Jan 2019

Akaka MA, Vargo SL, Lusch RF (2013) The complexity of context: a service ecosystems approach for international marketing. J Int Mark 21(4):1–20

Albrecht L, Ehmke JF (2016) Innovative Services in der Mobilitätsbranche: Eine Marktanalyse multimodaler Mobilitätsmanager. In: Nissen V, Stelzer D, Straßburger S, Fischer D (eds) Proceedings of the Multikonferenz Wirtschaftsinformatik, Ilmenau, pp 1355–1366

Allen DK, Brown A, Karanasios S, Norman A (2013) How should technology-mediated organizational change be explained? A comparison of the contributions of critical realism and activity theory. MIS Q 37(3):835–854

Baroody AJ, Hansen SW (2012) Changing perspectives: institutional logics of adoption and use of health information technology. In: Proceedings of the international conference on information systems, Orlando

Barth M, Boriboonsomsin K (2008) Real-world carbon dioxide impacts of traffic congestion. Transp Res Board J Transp Res Board 2058:163–171

Beirão G, Cabral JAS (2007) Understanding attitudes towards public transport and private car: a qualitative study. Transp Policy 14:478–489

Blackler F, Crump N, McDonald S (2000) Organizing processes in complex activity networks. Organ 7(2):277–300

Boivin C, Roch J (2006) Dominant organizational logic as an impediment to collaboration. Manag Decis 44(3):409–422

Bratzel S (2018) Junge Generation und die Mobilität der Zukunft. https://www.auto-institut.de/index_htm_files/Pressemitteilung_Mobilitaet_Junge%20Generation.pdf. Accessed 29 Jan 2019

Brust L, Breidbach CF, Antons D, Salge TO (2017) Service-dominant logic and information systems research: a review and analysis using topic modeling. In: Proceedings of the international conference on information systems, Seoul

Bundesministerium für Verkehr und digitale Infrastruktur (2017) Carsharing: BMVI gibt Startschuss. https://www.bmvi.de/SharedDocs/DE/Artikel/LA/carsharing-gesetz.html. Accessed 13 Oct 2017

Bunduchi R (2017) Overlapping logics and institutional alignment spaces: mapping the organisational trajectory of an IS innovation. In: Proceedings of the European conference on information systems, Guimarães

Busch PA (2018) Technology and institutional logics. In: Proceedings of the international conference on information systems, San Francisco

Callegati F, Giallorenzo S, Melis A, Prandini M (2017) Insider threats in emerging mobility-as-a-service scenarios. In: Bui T, Sprague Jr R (eds) Proceedings of the Hawaii international conference on system sciences, Hawaii, pp 2658–2667

Crawford K, Hasan HM (2006) Demonstrations of the activity theory framework for research in IS. Australas J Inf Syst 13(2):49–68

Eisenhardt KM (1989) Building theories from case study research. Acad Manag Rev 14(4):532–550

Eisenhardt KM, Graebner ME (2007) Theory building from cases: opportunities and challenges. Acad Manag J 50(1):25–32

Engeström Y (1987) Learning by expanding: an activity-theoretical approach to developmental research. Orienta-Konsultit, Helsinki

Engeström Y (2001) Expansive learning at work: toward an activity theoretical reconceptualization. J Educ Work 14(1):133–156

Firnkorn J, Müller M (2011) What will be the environmental effects of new free-floating car-sharing systems? The case of Car2Go in Ulm. Ecol Econ 70(8):1519–1528

Flick U (2009) An introduction to qualitative research. Sage, London

Gibbert M, Ruigrok W, Wicki B (2008) What passes as a rigorous case study? Strateg Manag J 29(13):1465–1474

Giesbrecht T, Schwabe G, Schenk B (2017) Service encounter thinklets: how to empower service agents to put value co-creation into practice. Inf Syst J 27(2):171–196

Gilsing R, Turetken O, Adali OE, Grefen PA (2018) Reference model for the design of service-dominant business models in the smart mobility domain. In: Proceedings of the international conference on information systems, San Francisco

Giuffrè T, Siniscalchi SM, Tesoriere G (2012) A novel architecture of parking management for smart cities. Procedia Soc Behav Sci 53:16–28

Gozman D, Currie W (2013) Building post crisis watchtowers: investment management systems and new institutional logics for regulatory compliance. In: Proceedings of the international conference on information systems, Milan

Grinevich V, Huber F, Karataş-Özkan M, Yavuz Ç (2019) Green entrepreneurship in the sharing economy: utilising multiplicity of institutional logics. Small Bus Econ 52(4):859–876

Hardyman W, Daunt KL, Kitchener M (2015) Value co-creation through patient engagement in health care: a micro-level approach and research agenda. Public Manag Rev 17(1):90–107

Hasan H, Smith S, Finnegan P (2016) An activity theoretic analysis of the mediating role of information systems in tackling climate change adaptation. Inf Syst J 27(3):271–308

Hein A, Scheiber M, Böhm M, Weking J, Rocznik D, Krcmar H (2018) Toward a design framework for service-platform ecosystems. In: Proceedings of the European conference on information systems, Portsmouth

Hildebrandt B, Hanelt A, Piccinini E, Kolbe LM, Nierobisch T (2015) The value of IS in business model innovation for sustainable mobility services—the case of carsharing. In: Thomas O, Teuteberg F (eds) Proceedings of the international conference on Wirtschaftsinformatik, Osnabrück, pp 1008–1022

Hoerstebrock T, Hahn A (2014) An approach towards service infrastructure optimization for electromobility. In: Hülsmann M, Fornahl D (eds) Evolutionary paths towards the mobility patterns of the future. Springer, Berlin, pp 265–280

INRIX (2019) Berlin ist Deutschlands Stauhauptstadt. http://inrix.com/press-releases/scorecard-2018-de/. Accessed 9 Jul 2019

Jarvis W, Halvorson W, Sadeque S, Johnston S (2014) A large class engagement (LCE) model based on service-dominant logic (SDL) and flipped classrooms. Educ Res Perspect 41:1–24

Jarzabkowski P (2003) Strategic practices: an activity theory perspective on continuity and change. J Manag Stud 40(1):23–55

Joiner KA, Lusch RF (2016) Evolving to a new service-dominant logic for health care. Innov Entrep Health 3:25–33

Jones WB, Cassady CR, Bowden RO Jr (2000) Developing a standard definition of intermodal transportation. Transp Law J 27(3):345–352

Karanasios S, Allen D (2013) ICT for development in the context of the closure of Chernobyl nuclear power plant: an activity theory perspective. Inf Syst J 23(4):287–306

Karanasios S, Allen D (2014) Mobile technology in mobile work: contradictions and congruencies in activity systems. Eur J Inf Syst 23(5):529–542

Karlsson F, Wistrand K (2006) Combining method engineering with activity theory: theoretical grounding of the method component concept. Eur J Inf Syst 15(1):82–90

Koskela-Huotari K, Edvardsson B, Jonas JM, Sörhammar D, Witell L (2016) Innovation in service ecosystems—breaking, making, and maintaining institutionalized rules of resource integration. J Bus Res 69(8):2964–2971

Kuutti K (1996) Activity theory as a potential framework for human–computer interaction research. In: Nardi BA (ed) Context and consciousness. Activity theory and human–computer interaction. Massachusetts Institute of Technology, London, pp 17–44

Leont'ev AN (1978) Activity, consciousness, and personality. Prentice-Hall, Englewood Cliffs

Lind M, Haraldson S (2015) (Air)port innovations as ecosystem innovations. In: vom Brocke J, Schmiedel T (eds) BPM—driving innovation in a digital world. Springer, Cham, pp 193–213

Lusch RF, Nambisan S (2015) Service innovation: a service-dominant logic perspective. MIS Q 39(1):155–175

Marx R, de Mello AM, Zilbovicius M, de Lara FF (2015) Spatial contexts and firm strategies: applying the multilevel perspective to sustainable urban mobility transitions in Brazil. J Clean Prod 108:1092–1104

Miles MB, Huberman AM, Saldaña J (2014) Qualitative data analysis: a methods sourcebook. Sage, Los Angeles

Nischak F, Hanelt A, Kolbe LM (2017) Unraveling the interaction of information systems and ecosystems—a comprehensive classification of literature. In: Proceedings of the international conference on information systems, Seoul

Nyende H (2018) The role of technology in value co-creation of maternal healthcare: a service-dominant logic perspective. In: Proceedings of the European conference on information systems, Portsmouth

Ordanini A, Parasuraman A (2011) Service innovation viewed through a service-dominant logic lens: a conceptual framework and empirical analysis. J Serv Res 14(1):3–23

Payne AF, Storbacka K, Frow P (2008) Managing the co-creation of value. J Acad Mark Sci 36(1):83–96

Prahalad CK, Bettis RA (1986) The dominant logic: a new linkage between diversity and performance. Strateg Manag J 7(6):485–501

Prebensen NK, Vittersø J, Dahl TI (2013) Value co-creation significance of tourist resources. Ann Tour Res 42:240–261

Reinhardt W (2012) Öffentlicher Personennahverkehr: Technik—rechtliche und betriebswirtschaftliche Grundlagen. Vieweg + Teubner, Wiesbaden

Rihoux B, Ragin CC (2009) Configurational comparative methods: qualitative comparative analysis (QCA) and related techniques. Sage, Los Angeles

Schmidt-Rauch S, Schwabe G (2014) Designing for mobile value co-creation—the case of travel counselling. Electron Mark 24(1):5–17

Schultze U, Bhappu AD (2017) Organization-sponsored sharing platforms: managing the dialectics of conflicting institutional logics. In: Proceedings of the international conference on information systems, Seoul

Schulz T, Überle M (2018) How institutional arrangements impede realization of smart ecosystems: the case of door-to-door mobility integrators. In: Proceedings of the European conference on information systems, Portsmouth

Schulz T, Gewald H, Böhm M (2018) The long and winding road to smart integration of door-to-door mobility services: an analysis of the hindering influence of intra-role conflicts. In: Proceedings of the European conference on information systems, Portsmouth

Scott WR (2008) Institutions and organizations: ideas and interests. Sage, Los Angeles

Shaheen SA, Guzman S, Zhang H (2010) Bikesharing in Europe, the Americas, and Asia. Past, present, and future. Transp Res Board J Transp Res Board 2143:159–167

Skoglund T, Karlsson ICM (2012) Appreciated—but with a fading grace of novelty! Traveller's assessment of, usage of and behavioural change given access to a co-modal travel planner. Procedia Soc Behav Sci 48:932–940

Slavova M, Karanasios S (2018) When institutional logics meet information and communication technologies: examining hybrid information practices in Ghana's agriculture. J Assoc Inf Syst 19(9):775–812

Spohrer JC, Maglio PP (2010) Toward a science of service systems: value and symbols. In: Maglio PP, Kieliszewski CA, Spohrer JC (eds) Handbook of service science. Springer, Boston, pp 157–194

Statistisches Bundesamt (2011) Großstädte in Deutschland. https://www.destatis.de/DE/ZahlenFakten/LaenderRegionen/Regionales/Gemeindeverzeichnis/Administrativ/GrosstaedteEinwohner.html. Accessed 27 Dec 2018

Strauss AL, Corbin JM (1998) Basics of qualitative research: techniques and procedures for developing grounded theory. Sage, Thousand Oaks

Su N (2013) Internationalization strategies of Chinese IT service suppliers. MIS Q 37(1):175–200

Teubner T, Flath CM (2015) The economics of multi-hop ride sharing. Creating new mobility networks through IS. Bus Inf Syst Eng 57(5):311–324

United Nations Department of Economic and Social Affairs (2015) World urbanization prospects: the 2014 revision, New York. https://population.un.org/wup/Publications/Files/WUP2014-Report.pdf. Accessed 04 Jan 2019

Vargo SL, Lusch RF (2004) Evolving to a new dominant logic for marketing. J Mark 68(1):1–17

Vargo SL, Lusch RF (2017) Service-dominant logic 2025. Int J Res Mark 34(1):46–67

Vargo SL, Maglio PP, Akaka MA (2008) On value and value co-creation: a service systems and service logic perspective. Eur Manag J 26(3):145–152

Vargo SL, Wieland H, Akaka MA (2015) Innovation through institutionalization: a service ecosystems perspective. Ind Mark Manag 44:63–72

Verband Deutscher Verkehrsunternehmen (2018) 2017 Statistik, Köln. https://www.vdv.de/vdv-statistik-2017.pdfx. Accessed 29 Jan 2019

Vickers I, Lyon F, Sepulveda L, McMullin C (2017) Public service innovation and multiple institutional logics: the case of hybrid social enterprise providers of health and wellbeing. Res Policy 46(10):1755–1768

Vygotsky LS (1978) Mind in society: the development of higher psychological processes. Harvard University Press, Cambridge

Watson RT, Lind M, Haraldson S (2012) The emergence of sustainability as the new dominant logic: implications for information systems. In: Proceedings of the international conference on information systems, Orlando

Weeger A, Haase U (2016) How contradictions facilitate evolutionary transformation: an exploration into the dynamics of business-IT alignment from the perspective of activity theory. In: Proceedings of the European conference on information systems, Istanbul

Weeger A, Ott-Schwenk A (2017) What teams need to be clear about—an activity theoretical perspective on shared understanding in health IS implementation. In: Leimeister JM, Brenner W (eds) Proceedings of the international conference on Wirtschaftsinformatik, St. Gallen, pp 544–558

Willing C, Brandt T, Neumann D (2017a) Electronic mobility market platforms—a review of the current state and applications of business analytics. Electron Mark 27(3):267–282

Willing C, Brandt T, Neumann D (2017b) Intermodal mobility. Bus Inf Syst Eng 59(3):173–179

Yin RK (2014) Case study research: design and methods. Sage, Thousand Oaks

Appendix K. Value Co-Creation and Co-Destruction in Service Ecosystems: The Case of the Reach Now App (P9)

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Value co-creation and co-destruction in service ecosystems: The case of the Reach Now app

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ABSTRACT

In recent years, a change in business logic from goods-dominant (G-D) to service-dominant (S-D) logic can be observed widely. For instance, in the case of the mobility sector, companies such as Daimler AG and the BMW Group are shifting from solely producing cars to also providing mobility services. One fruit of their efforts is the Reach Now app, which supports users by combining multiple mobility services. Although such an app can contribute significantly to achieving smart mobility and thereby making the use of the private car less predominant, only a relatively small number of people use it. In this article, we adopt the S-D logic perspective to analyze the link between value formation (i.e., value co-creation and co-destruction) in customer-to-business relationships and business-to-business relationships in the service ecosystem of the Reach Now app based on an analysis of customer reviews of the Reach Now app in the Android Google Play Store between 2016 and 2019. We complement this analysis with interviews with representatives from six German public transport organizations and the Moovel Group GmbH, the app provider. Based on our analysis, we develop an interactional phase-based perspective on value formations in the tripartite relationship between app users, the Moovel Group GmbH, and public transport organizations. Our work complements previous S-D logic studies that (1) do not focus on information technology-enabled value formation, (2) neglect the concept of value co-destruction, (3) analyze only single dyadic actor-to-actor relationships, and/or (4) examine an established service ecosystem.

1. Introduction

Technological progress such as big data collection and analysis and the rise of the platform economy have affected almost all industries, changed production and service processes, and disrupted successful business models (Malthouse et al., 2019; van Riel et al., 2019). The automotive industry is particularly affected by these developments (Wells et al., 2020). Ever since Carl Benz patented the vehicle in 1886 (Stiller et al., 2011), the business model of automotive companies has, until recently, entailed selling vehicles to private and business customers. As the sharing economy driven by platforms emerged (Nadeem et al., 2020), automotive companies started adapting their business model by rolling out car-sharing services, primarily in large cities. For example, car2go, a subsidiary of Daimler AG, launched the world's first free-floating car-sharing system in Ulm, Germany, in 2009 (Firnkorn and Müller, 2011). Nevertheless, the main business of automotive companies worldwide remains vehicle sales – a business model which is increasingly outdated and obsolete.

Cities around the world face many problems associated with the use of private cars, including traffic jams, a lack of parking spaces, as well as noise and air pollution caused by combustion engines, which threatens the health and wellbeing of their citizens (Schreieck et al., 2018; Willing et al., 2017a; 2017b). Simultaneously, studies indicate that use of mobility services such as car-sharing (Firnkorn and Müller, 2011;

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Hildebrandt et al., 2015), bike-sharing (Yin et al., 2019), and ride-sharing (Rayle et al., 2014; Teubner and Flath, 2015), has increased in many urban areas. The spread of information technology (IT), in particular of the smartphone, has contributed to this development by making it easier and more convenient to use mobility services.

In the future, smartphone apps (i.e., platforms) bundling access to mobility services from a number of providers, can further drive this development. Scientific literature (e.g., Hein et al., 2018; Ye et al., 2020) refers to this concept also as 'mobility as a service' (MaaS). Some such apps not only enable users to compare and purchase different mobility services, but also provide them with individualized, context-aware, and dynamic recommendations of mobility service bundles to facilitate comfortable mobility from an origin to a destination (Schulz et al., 2018). According to Gretzel et al. (2015, p. 179) such a service that reflects "technological, economic, and social developments Direct quote fuelled by technologies that rely on sensors, big data, open data, new ways of connectivity and exchange of information (e.g., Internet of Things, RFID, and NFC) as well as abilities to infer and reason" can be considered 'smart'.

To date, these apps and scientific research into them are still in their infancy. In the recent past, several smart mobility app providers, including the Moovel Group GmbH (Daimler AG), have entered the German-speaking mobility market and are competing for customers and mobility providers. Comparisons of the apps conducted by Albrecht and Ehmke (2016) and Willing et al. (2017a; 2017b) show that most apps only include a rather low number of mobility services offered by few mobility providers. For example, only 44% of the analyzed apps provide information about the public transport service of at least one company (Albrecht and Ehmke, 2016). This is one reason why (potential) users currently tend to find these apps rather unattractive and an inadequate substitute for private car-based mobility. In order to make the Moovel (later renamed Reach Now) app more attractive and thus become more successful mobility service providers, Daimler AG and the BMW Group entered into a joint venture in 2019 (Moovel, 2019).

A large number of scientific studies (for an overview see Brust et al., 2017) have taken the service-dominant (S-D) logic perspective to analyze resource integration and service exchange (i.e., value co-creation) among the actors of a service ecosystem. This S-D logic perspective, originally introduced into marketing by Vargo and Lusch (2004), contrasts with the goods-dominant (G-D) logic perspective, which focuses on value creation in the case of a company that manufactures things like cars. As with the current study, some previous studies focus on value co-creation among different actors located in a mobility context (e.g., Alexander and Jaakkola, 2011; Gebauer et al., 2010) and in some cases the value co-creation is IT-enabled (e.g., Gilsing et al., 2018; Hein et al., 2018; Turetken et al., 2019).

Of particular relevance to our research are studies investigating value co-creation in single dyadic actor-to-actor relationships embedded in service ecosystems comparable to that surrounding the Moovel Group GmbH (hereafter referred to as the Moovel Group). Several studies have examined why German mobility providers, especially public transport organizations, have not established business-to-business relationships with smart mobility app providers (e.g., Schulz and Ikonomou, 2020; Schulz and Überle, 2018), and how such a relationship can be initiated (Schulz et al., 2020c). Schulz et al. (2020a) examine value co-creation among different public transport organizations and two smart mobility app providers (private and public) and Schulz et al. (2020b) focus on customer-to-business relationships and determined the preference structures of potential users to predict their choice decision in the case of competing smart mobility app providers.

Currently, however, it is unclear why so few people use apps like the Reach Now app or stop using it. In order to understand the factors driving smart mobility app use and discontinuation, it is necessary to analyze the value formation in the customer-to-business relationships that takes into account both value co-creation and co-destruction (Echeverri and Skålén, 2011) reflected by a loss of resources (financial, physical, etc.) and negative feelings (e.g., anger, dissatisfaction, and frustration) (Sthapit and Björk, 2019). However, since such value formation takes place in a service ecosystem, value co-creation and co-destruction between the smart mobility app provider and mobility providers (i.e., in business-to-business relationships) must also be considered. This article addresses these gaps, asking the following research question:

RQ: How are value co-creation and co-destruction, the components of value formation, linked across dyadic actor-to-actor relationships in the service ecosystem of the Moovel Group?

Taking a case study approach (Benbasat et al., 1987; Yin, 2018), we analyze customer reviews of the Reach Now app and interviews with experts from the Moovel Group and German public transport organizations. Based on our analysis, we provide an interactional phase-based understanding of value formation in the tripartite relationship between customers, the Moovel Group, and the public transport organizations.

This study has practical implications for the service ecosystem of the Moovel Group and for comparable service ecosystems and can thus support non-private car-based mobility. In terms of theory, we complement the general S-D logic perspective research by (1) focusing on IT-enabled value formation (e.g., Breidbach and Ranjan, 2017; Haki et al., 2019; Kim et al., 2018), (2) considering the concept of value co-destruction (e.g., Laud et al., 2019; Plé and Cáceres, 2010; Prior and Marcos-Cuevas, 2016), (3) analyzing the interplay among multiple dyadic actor-to-actor relationships (e.g., Blaschke et al., 2019; Breidbach and Maglio, 2016; Sigala, 2018), and (4) examining a nascent service ecosystem (Hodapp et al., 2019).

The remainder of the article is structured as follows: In the theoretical background section the foundations of the S-D logic perspective are explained. Next, the case study methodology and the analysis of customer reviews and expert interviews are described. We then present and discuss our results and their implications and identify the limitations of our work and avenues for future research.

2. Service-dominant logic perspective

2.1. Service ecosystem and service platform

The service-dominant (S-D) logic perspective is well established in many research fields, including service science (e.g., Čaić et al., 2018; Maglio et al., 2009; Spohrer and Maglio, 2010; van Riel et al., 2019). An overview of information systems (IS) studies applying the S-D logic perspective is provided by the literature review by Brust et al. (2017). Several recent (IS) studies apply the S-D logic perspective in a mobility context (e.g., Schulz et al., 2020a; 2020b; 2020c; Yin et al., 2019), and some simultaneously take a business model perspective (Gilsing et al., 2018; Hein et al., 2018; Turetken et al., 2019).

The emergence and widespread dissemination of the S-D logic perspective is based on a fundamental shift in business logic "in which service provision rather than goods is fundamental to economic exchange" (Vargo and Lusch, 2004, p. 1). S-D logic has taken hold in many industries, including the mobility industry. For example, automotive companies, such as Daimler AG, are moving beyond the traditional model of car manufacturing by also providing services such as apps like Reach Now (Moovel, 2019), which provides access to multiple mobility services such as public transport, car-sharing and bike-sharing, or by operating a car-sharing service such as car2go (Firnkorn and Müller, 2011). The change from goods-dominant (G-D) logic to S-D logic also takes place on the demand side. The young adult generation is less inclined to buy a car than older generations (Circella et al., 2017; Umweltbundesamt, 2019) and more inclined to use app-based mobility services such as ride-sharing (Rayle et al., 2014).

Research considering the S-D logic perspective is traditionally centered on three concepts: (1) the service ecosystem, (2) the service platform, and (3) value co-creation (Hein et al., 2018; Lusch and Nambisan, 2015). A service ecosystem represents an actor-to-actor network and can be defined as "a relatively self-contained, self-adjusting system of mostly loosely coupled social and economic (resource-integrating) actors connected by shared institutional logics and mutual value creation through service exchange" (Lusch and Nambisan, 2015, p. 161). Service ecosystems vary in size, ranging from small (e.g., a household, a company) to large (e.g., a nation, the global market) (Koskela-Huotari et al., 2016). The service ecosystem concept has strong parallels with network and cluster theory (e.g., Sedoglavich and Dabić, 2017), which highlights the need for collaboration among actors to ensure mutual benefit and even survival.

An exemplary service ecosystem of a smart mobility app provider that can be adapted for the case of the Reach Now app is described by Schulz and Überle (2018). The key actors are the Moovel Group, with Daimler AG and the BMW Group as its parent companies, which provides the Reach Now app, various mobility providers, including public transport, car-sharing companies such as car2go and DriveNow, bike-sharing companies, and customers. Other actors indirectly embedded in the service ecosystem include the federal government of Germany, which promotes the provision of car-sharing parking spaces near public transport stations to support and facilitate the use of these mobility services (Bundesministerium für Verkehr und digitale Infrastruktur, 2017). Each actor can be embedded in multiple service ecosystems simultaneously. For example, Daimler AG is embedded in the service ecosystem of the Moovel Group and of car2go because it is a parent company of both.

As can be seen from these two examples, digitalization contributes to the emergence and spread of service ecosystems. In the non S-D logic literature, several authors (e.g., Brendel et al., 2020; Hildebrandt et al., 2018; 2015; Meng et al., 2020) describe how IT, such as technologies for instant access and vehicle monitoring, but in particular the use of smartphones, supports and influences resource integration and service exchange among actors in the case of car-sharing.

Whereas in the past employees were responsible for tasks such as refueling and relocation of vehicles, these are now often performed by customers (Brendel et al., 2020; Meng et al., 2020). In the case of peer-to-peer car-sharing, members even make their private car available to other members via the Internet (Ballús-Armet et al., 2014). By using IT, car-sharing companies can thus save costs (Brendel et al., 2020), make their service attractive to potential customers (Hildebrandt et al., 2015; Meng et al., 2020) and contribute to the long-term viability of their service ecosystem by mitigating careless and wasteful use of resources through customers (e.g., reckless and wasteful driving) (Hildebrandt et al., 2018).

The coordination mechanisms for actors and their service-for-service exchange within and between service ecosystems are institutions and institutional arrangements (a synonym for institutional logics) (Lusch and Nambisan, 2015; Vargo and Lusch, 2017). Institutions reflect rules, norms, practices, and beliefs that enable or constrain action, while institutional arrangements reflect assemblages of institutions (Vargo and Lusch, 2016; 2017). For example, a single, specific, isolated industrial norm represents an institution, while various industrial norms and company and national cultures reflect institutional arrangements (Koskela-Huotari et al., 2016).

When the actors of a service ecosystem share an institution and institutional arrangements, their resource integration and their service exchange is often facilitated. However, shared institutional arrangements can also constrain the resource integration and service exchange among actors by leading to ineffective dogmas, ideologies, and dominant institutional logics (e.g., when actors follow the G-D logic) (Koskela-Huotari et al., 2016; Schulz et al., 2020a; Vargo and Lusch, 2016).

A service platform can be defined as "a modular structure that consists of tangible [e.g., metal, IT hardware] and intangible components [e.g., digital artifacts] (resources) and facilitates the interaction of [service ecosystem] actors and resources (or resource bundles)" (Lusch and Nambisan, 2015, p. 162). In other words, "service platforms are any kind of artifacts that act as the mediator, enabler, facilitator, or distribution mechanism for service provisioning. For instance, jet turbines are service platforms facilitating the service of airtime" (Haki et al., 2019, p. 495). In this study, we focus on the Reach Now app that represents a service platform for its surrounding actor-to-actor network.

Schulz et al. (2019) identify operand (e.g., interfaces and information system architecture) and operant (e.g., security and privacy capability) resources that a smart mobility app provider integrates. Without explicitly adopting the S-D logic perspective, Albrecht and Ehmke (2016) as well as Willing et al. (2017a; 2017b) show that currently available smart mobility apps have several shortcomings (e.g., no mobile tickets are offered) that indicate a lack of resource integration and service exchange between app providers, mobility providers, and customers (Schulz et al., 2020c). Based on these results, Schulz et al. (2020b) perform a conjoint analysis, finding, for example, that car drivers are the only potential user group for whom the app price is not particularly important in the choice decision.

2.2. *Value co-creation*

Value co-creation involves the resource integration and the service exchange among actors of a service ecosystem, including customers (Vargo and Lusch, 2017). Whereas G-D logic postulates that customers are buyers of products (e.g., cars) manufactured by companies, S-D logic assumes an interaction process between companies and their customers (Vargo and Lusch, 2004). Based on this understanding, Payne et al. (2008) identify three types of processes that underlie value co-creation among these two actors: customer value-creating processes, supplier value-creating processes, and encounter processes. Such processes encompass, among others, the procedures, tasks and activities performed by the actors.

However, value co-creation is not the result of the resource integration and service exchange in a single dyadic actor-to-actor relationship between a customer and supplier, but rather multiple actors embedded in a service ecosystem are involved in value co-creation (Lusch and Nambisan, 2015; Rahman et al., 2019). For instance, Dey et al. (2019) illustrate how value co-creation among multiple actors, such as multinational companies, not-for-profit organizations, and the government, leads to technology upgrades (diffusion of smartphones and apps) in the case of mobile telephone industry in Bangladesh.

By focusing on the outcome of value co-creation for an individual customer, Nambisan and Nambisan (2008) argue that the customer can experience different types of value, namely pragmatic, hedonic, usability, and sociability experience. As applied to the case of the Reach Now app, users may experience sociability, for example, by perceiving themselves as members of the group of environmentally conscious people. This illustrates how actors beyond the dyadic customer-to-business relationship, such as other users or members of a perceived group (e.g., Mikalef et al., 2017; Rahman et al., 2019), are engaged in value co-creation.

In S-D logic, "value is fundamentally derived and determined in use – the integration and application of resources in a specific context – rather than in exchange – embedded in firm output and captured by price [G-D logic]" (Vargo et al., 2008, p. 145). In this vein, Gilsing et al. (2018) observe that people increasingly look at the value, such as flexibility and ease-of-use, which is offered by car-sharing apps, in contrast to appreciating the intrinsic value of a car they might buy. In line with this example, Payne et al. (2008) note that technical breakthroughs, such as the development and diffusion of the smartphone, and changes in industrial logic, such as Daimler AG's and BMW Group's provision of the Reach Now app, often offer opportunities for value co-creation.

IT can serve both as an operand and as an operant resource in value co-creation among actors embedded in a service ecosystem (Lusch and Nambisan, 2015). As an operand resource, IT represents an enabler or facilitator of value co-creation, providing actors the means to carry out resource integration and service exchange effectively and efficiently (Haki et al., 2019; Hein et al., 2018; Lusch and Nambisan, 2015). For example, users of the Reach Now app (which represents a service platform) can use smartphone technology to passively or actively provide information about how crowded their bus or train is (Nunes et al., 2014). An increasing number of German public transport companies also now use sensors in vehicles to track and monitor their position and predict delays (Schulz et al., 2020c).

In its role as operant resource, IT acts as an initiator or trigger for value co-creation among the actors. For instance, the "digital components of a service platform may seek out and pursue unique resource integration opportunities on their own, and in the process, engage with (or act upon) other actors" (Lusch and Nambisan, 2015, p. 167). In the present context, among others, the algorithm for calculating an app user's optimal route (the choice of mobility services, respectively) could dynamically adjust the recommendation based on information about changes in contextual factors (e.g., weather conditions, delays of vehicles, and capacity utilizations), user preferences, and current user behavior.

Despite the dual roles of IT as operand and operant resource and its great importance for value co-creation among service ecosystem actors, scientific research on these roles remains limited. In line with other scholars (Blaschke et al., 2019; Breidbach and Ranjan, 2017; Haki et al., 2019; Mikalef et al., 2017; Schüritz et al., 2019, etc.), Breidbach and Maglio (2016, p. 73 and p. 83) conclude that "we know very little about how economic actors engage in the process of value co-creation in traditional, co-located contexts […], let alone in technology-enabled ones" and that "future work may consider how individuals in complex multi-actor value networks perceive value through use or experience after exchanging and integrating resources by means of ICT".

Much of the scientific literature has focused on value co-creation (1) in established service ecosystems (Hodapp et al., 2019), (2) in dyadic actor-to-actor relationships (e.g., Blaschke et al., 2019; Breidbach and Maglio, 2016), and/or (3) in a non-IT-enabled environment (e.g., Blaschke et al., 2019; Breidbach and Maglio, 2016; Breidbach and Ranjan, 2017; Haki et al., 2019; Kim et al., 2018). Overall, there is a lack of studies that examine IT-enabled value co-creation in a nascent service ecosystem at the network analysis level, which thus move beyond dyadic analysis of value co-creation such as Alexander and Jaakkola's (2011) examination in the context of railway stations in Scotland and Gebauer et al.'s (2010) examination of public transport service provision in Switzerland. With regard to IT, Haki et al. (2019) highlighted that the IS community can contribute to the shift from the G-D logic to the S-D logic through the analysis and design of digital service platforms following a value co-creation perspective.

The scientific literature provides valuable insights into value co-creation among actors using a service platform. Pappas et al. (2017) and Mikalef et al. (2017) take a customer perspective in examining the value co-creation in social commerce. Social commerce is a subset of electronic commerce, in which (potential) customers use social media to participate in the design, marketing, and/or sale of a product/service. Both studies find a strong correlation between the degree of value co-creation among potential customers and their purchase intention. As applied to the Reach Now app, customers may submit an online review to inform other (potential) customers about their user experience or provide information about a specific mobility provider and its service, such as delays or capacity utilization.

Other studies focus on how IT, especially a service platform, enables value co-creation among actors. Breidbach and Ranjan (2017) analyze how peer-to-peer lending platforms facilitate value co-creation among borrowers and lenders by adopting one or more of four practices. For instance, the interaction practice assists and guides borrowers and lenders. Kim et al. (2018) identify value co-creation in the case of a digital content platform through convergence, re-purposing, and co-production among actors such as broadcasting companies, entertainment agencies, and fans.

Schüritz et al. (2019) illustrate that value co-creation between a data-driven service provider and a customer depends on the size of their so-called 'joint sphere'. The joint sphere can be enlarged through increased interaction (e.g., data exchange, automated actions), improved access to the processes and/or behaviors of the customer, and greater decision-making power, which is defined as the degree to which one actor can decide things for another actor. Hodapp et al. (2019) identify the challenges for value co-creation among actors enabled by nascent 'Internet of Things' platforms, including defining the roles and responsibilities of each actor, establishing data protection requirements and data ownership regulations, and acquiring and protecting crucial information property.

2.3. *Value co-destruction*

Resource integration and service exchange among actors in a service ecosystem is not necessarily accompanied by value co-creation. Plé and Cáceres (2010, p. 431) define value co-destruction as "an interactional process between service systems that results in a decline in at least one of the systems' well-being (which, given the nature of a service system, can be individual or organizational)". The term 'service system' is synonymous with 'service ecosystem' (see Nischak et al. (2017) and Spohrer et al. (2008) for a more detailed discussion of these terms) and 'interactional process' highlights the assumption of the S-D logic perspective that value is created (and thus also destroyed) through resource integration and service exchange by multiple actors, including customers, and is not embedded in firm output (G-D logic).

While the concept of value co-destruction is not part of the original S-D logic perspective (Lusch and Nambisan, 2015; van Riel et al., 2019; Vargo and Lusch, 2004), we propose that it is a valuable complement to its three main concepts: service ecosystem, service platform, and value co-creation. While some research (e.g., Rahman et al., 2019; Sigala, 2018; van Riel et al., 2019; Yin et al., 2019) considers value co-destruction, most studies adopting the S-D logic perspective focus solely on the concept of value co-creation. To illustrate this bias, a search in the electronic library of the Association for Information Systems (AISeL) on 10 January 2020 yielded 629 hits for 'value co-creation', but only 15 hits for 'value co-destruction', a number of which (e.g., Kokko et al., 2018; Lintula et al., 2018) focus on value co-destruction in online and mobile games. Plé (2016, p. 154) calls this positive bias in the S-D logic literature value "co-creation myopia" and there are several calls for further research on value co-destruction (e.g., Laud et al., 2019; Plé, 2017; Plé and Cáceres, 2010; Prior and Marcos-Cuevas, 2016).

Leroi-Werelds (2019, p. 667) identifies the importance of this concept, asking "When and how can value be destroyed instead of created in a service ecosystem?" and "When and how can technologies destroy instead of create customer value?". The Uber app illustrates IT-enabled value co-destruction, in that while service ecosystems may create value for certain actors, such as app users, they often destroy value for other actors, such as cab drivers. This leads to unsustainable service ecosystems (Sthapit and Björk, 2019; van Riel et al., 2019).

There have been various attempts to conceptualize the relationship between the concepts of value co-destruction and value co-creation. Rahman et al. (2019, p. 538) view value co-creation as "the outcome of a dialectical process that involves [value] co-destruction. Furthermore, the process is not just based on dyadic interrelationship between buyers and sellers, as often suggested in academic literature. Multiple stakeholders engage and interact at multiple levels that constitute co-innovation and co-production of ideas, processes and outcomes". In other words, value co-destruction and co-innovation/co-production constitute the two integral parts of value co-creation.

This conceptualization is problematic because depicting value co-creation as the "net outcome" (Rahman et al., 2019, p. 540) of the dialectical process implicitly assumes that co-innovation and co-production exceed value co-destruction. The authors' argument,

Table I
Overview of the literature on value formation in dyadic actor-to-actor relationships located in a mobility context.

Focus	Environment	Customer-to-business relationships	Business-to-business relationships
Value co-destruction	Face-to-face	Echeverri and Skålén (2011); Gohary et al. (2016)	–
	Digital	Dolan et al. (2019); Frau et al. (2018); Sthapit and Björk (2019); Yin et al. (2019)	Schulz and Überle (2018)[1]; Schulz et al. (2020c)[1]; Schulz and Ikonomou (2020)[1]; Zimmermann et al. (2020)
Value co-creation	Face-to-face	Alexander and Jaakkola (2011); Echeverri and Skålén (2011); Gebauer et al. (2010); Gohary et al. (2016)	Alexander and Jaakkola (2011)
	Digital	Dolan et al. (2019); Gilsing et al. (2018)[2]; Hein et al. (2018)[2]; Nunes et al. (2014); Schulz et al. (2020b); Turetken et al. (2019)[2]; Yin et al. (2019)	Gilsing et al. (2018)[2]; Hein et al. (2018)[2]; Schulz et al. (2019); Schulz et al. (2020a; 2020c); Turetken et al. (2019)[2]

[1] The authors used the term value co-creation. However, they investigate an entire lack of resource integration and service exchange by mobility providers, and thus, according to the conceptualization used in this study, value co-destruction (antonym of value co-creation).

[2] The authors adopt a business model perspective.

which is based in part on Schumpeter (2012), may be justified for a study focused on value co-creation and co-destruction among actors in the smartphone industry in Bangladesh and the Indian province of West Bengal. However, in a single dyadic actor-to-actor relationship or among actors of a specific service ecosystem, the 'net outcome' of the dialectical process need not be positive, in other words, the co-innovation and co-production need not exceed value co-destruction. In the research at hand, for example, this conceptualization, assuming that value co-creation takes place at the higher level, does not sufficiently explain why users stop using the Reach Now app.

For this reason, we adopt an alternative conceptualization and consider value co-creation and co-destruction as two sides of the same coin, positing value co-destruction as an antonym of value co-creation (Laud et al., 2019; Plé and Cáceres, 2010). In this context, the 'same coin' represents the resource integration and service exchange of actors, which, according to the traditional S-D logic literature (Vargo and Lusch, 2004; 2017), underlie value co-creation. In line with Echeverri and Skålén (2011), we use the term 'value formation' as an umbrella term for value co-creation and co-destruction. This conceptualization takes into account that the 'net outcome', which results from the resource integration and service exchange of an actor, can be positive or negative.

Value formation is difficult to observe empirically, which may explain the conceptual nature of many studies drawing on the S-D logic perspective (Vargo and Lusch, 2017). In conceptualizing value co-creation, Storbacka et al. (2016) recommend using 'actor engagement' as the microfoundation, which focuses on both the disposition of an actor to engage in resource integration, and its performed resource integration in a service ecosystem. Other scholars (e.g., Laud et al., 2019; Smith, 2013) assume that value co-destruction causes a negative shift in 'well-being' among actors in a service ecosystem and can thus point to value co-destruction. Similarly, Chen et al. (2020) argued that value co-creation leads to a positive change in well-being.

Manifestations of negative well-being include negative feelings (e.g., anger, dissatisfaction, and frustration) and loss of resources (financial, physical, etc.) for an actor (Sthapit and Björk, 2019). Value co-destruction already exists if there is a "lack of resources to integrate[, i.e.] the unavailability of resources or the belief of such by at least one interacting actor" or an "unwillingness to integrate resources[, i.e.] the deliberate withholding or withdrawing of resources by at least one interacting actor" (Laud et al., 2019, p. 869). In the study at hand, for example, Moovel Group not enabling users to purchase mobile tickets for the public transport services recommended by the Reach Now app within the app constitutes value co-destruction for users, manifested in perceived negative well-being (e.g., inconvenience, frustration, wasted time).

In the following, we review studies focusing on value co-destruction in actor-to-actor relationships in a mobility context. An overview is provided in Table I. We distinguish whether the studies analyze value co-destruction in customer-to-business relationships (dyad 1) or in business-to-business relationships (dyad 2). In addition, we differentiate whether the studies investigate value co-destruction in a face-to-face or digital environment. Echeverri and Skålén (2011) and Gohary et al. (2016) examine value co-destruction between customers and a public transport company in a face-to-face environment. Among other results, they show that the discontinuation of tickets sales by the tram driver leads to value co-destruction if customers are not familiar with or do not understand the new ticketing practices (Echeverri and Skålén, 2011).

Other authors analyze value co-destruction in digital customer-to-business relationships, primarily relying on negative reviews and complaints posted online and available to potential customers and the companies being reviewed. The studies focused on two airlines – Qantas Airways Limited and its subsidiary Jetstar Airways Pty Limited (Dolan et al., 2019; Frau et al., 2018) – a bike-sharing company (Yin et al., 2019), and Uber Technologies Inc. (Sthapit and Björk, 2019).

Negative customer reviews are evidence of customer dissatisfaction with the mobility and related services (e.g., app installation, registration, crashes, inaccuracy), as well as negative feelings, such as anger and frustration (Yin et al., 2019). By dissuading potential customers from initiating a customer-to-business relationship (i.e., joining the service ecosystem), negative customer reviews can lead to value co-destruction for the Moovel Group in the form of lost revenue, but negative customer reviews can also inspire it to improve the Reach Now app, which can in turn lead to value co-creation. Finally, Frau et al. (2018) investigate additional actor-to-actor relationships, such as between the airline and an anti-brand organization or a hacker.

Four studies (Schulz et al., 2020c; Schulz and Ikonomou, 2020; Schulz and Überle, 2018; Zimmermann et al., 2020) examine the lack of actor-to-actor relationships between a company offering a smart mobility app and mobility providers such as public transport and car-sharing companies. These studies complement the S-D logic perspective with additional theories, such as activity theory (Schulz et al., 2020c) and power theory (Schulz and Ikonomou, 2020). Their results revealed that the mobility providers often do not possess the necessary resources, such as real-time timetable information and mobile tickets, or are not willing to provide the resources for strategic reasons.

In addition, the studies focusing on value co-creation between mobility service ecosystem actors (see the explanations in the previous section) are classified in Table I. In summary, to date, almost only single dyadic actor-to-actor relationships have been investigated with regard to value co-creation or value co-destruction. This finding is consistent with the research gap that we previously described for the S-D logic literature in general with respect to IT-enabled value formation in service ecosystems (e.g., Blaschke et al., 2019; Breidbach and Maglio, 2016; Laud et al., 2019; Rahman et al., 2019; Sigala, 2018).

In other words, currently there is a lack of understanding of the link between value formations in dyadic actor-to-actor relationships in a service ecosystem, especially in the case of a nascent service ecosystem (Hodapp et al., 2019). As a step toward filling this research gap, the present study analyzes the dyadic relationships between the Moovel

Group and the users of its Reach Now app, as well as the dyadic relationships between the Moovel Group and the public transport organizations.

3. Methodology, data collection, and analysis

3.1. Case study research

According to the definition of Benbasat et al. (1987, p. 370) "a case study examines a phenomenon in its natural setting, employing multiple methods of data collection to gather information from one or a few entities (people, groups, or organizations). The boundaries of the phenomenon are not clearly evident at the outset of the research and no experimental control or manipulation is used". Data can be collected by conducting interviews, in quantitative surveys, through observation, and from archives (Eisenhardt, 1989).

The use of a case study research design is appropriate when the research question is a 'how' or 'why' question, as in our case (Benbasat et al., 1987; Yin, 2018). Benbasat et al. (1987) posit four criteria in determining whether a case study research design is appropriate, including when the analysis focuses on a contemporary event (here: the emergence of app-based service ecosystems for smart mobility) and when there is no strong theoretical basis in terms of the phenomenon of interest (here: the link between value formations in different dyadic actor-to-actor relationships of a service ecosystem). In conducting our case study, we followed the six phases suggested and described by Yin (2018).

We adhered to Stake (1994) criteria for selecting a case, including considering previous cases that may contribute to understanding its singularity, as well as evaluating its nature, its historical background, its physical setting and its context (e.g., economic, political, legal), and access to informants. Based on these criteria, we chose the Moovel Group's Reach Now app due to several unique characteristics (an overview of competitor apps available in German-speaking Europe is provided by Albrecht and Ehmke (2016) and Willing et al. (2017a; 2017b)):

(1) The Reach Now app has a higher number of downloads in the Android Google Play Store (Android Google Play Store, 2020) than competitor apps (e.g., fromAtoB, Qixxit, and RouteRANK);
(2) The Reach Now app is operated as a joint venture by Daimler AG and the BMW Group (Moovel, 2019) and thus represents the efforts of two of the world's largest automotive companies to make the step from solely manufacturing cars to also providing mobility services;
(3) Many of the available smart mobility apps, including the Reach Now app, focus on the European market, and in particular on Germany (Albrecht and Ehmke, 2016; Willing et al., 2017a; 2017b). The reasons for this include the legal conditions, high public pressure, and pre-existing infrastructure in Germany, which support the shift from private car use towards more sustainable mobility (Marx et al., 2015; Willing et al., 2017b). Shifts in mobility behavior can be observed in particular in the young adult generation, which may contribute to the demand for these apps. The recent study by the Umweltbundesamt (2019) shows, for instance, that the share of 18- to 29-year-old German residents who have a driver's license and own a car declined between 2002 and 2017; and
(4) The website of the Moovel Group provides information about existing business-to-business relationships with public transport companies and transport and tariff associations (local representatives of public transport companies) (Moovel, 2020). This information makes it possible to identify potential interviewees with insights into the value formation that emerges in the business-to-business relationships.

3.2. Customer reviews

Following the lead of previous studies (e.g., Dolan et al., 2019; Sthapit and Björk, 2019) examining value co-creation and/or value co-destruction between a company and its customers in a digital environment, we analyzed customer reviews. Customer reviews represent archival data and have the advantage that they are usually written immediately after the trip and therefore the ratings are not distorted by observations. In addition, customer reviews offer valuable insights into the well-being of customers by revealing feelings such as anger, dissatisfaction, and happiness, as well as loss of resources (financial, physical, time, etc.) (Sthapit and Björk, 2019).

First, we extracted the 506 customer reviews provided for the Reach Now app in the Android Google Play Store between 2016 and 2019 and imported them to NVivo 12 for analysis. The customer reviews provided in this period of time represent a relatively high share of the 2391 total customer reviews available for the Reach Now app at the time of our case study. This analysis period was defined to take into account that value formation in customer-to-business relationships changes over time due as the service develops.

Comparisons of the Reach Now app with competitor apps revealed that they have similar strengths and weaknesses (Albrecht and Ehmke, 2016; Willing et al., 2017a; 2017b), which should make the results for the value formation transferable. For example, Albrecht and Ehmke (2016) show that only 44% of the apps offering smart mobility solutions for German-speaking Europe provide information (e.g., ticket prices, real-time timetable information) about at least one public transport service.

On an aggregate level, the star ratings (one to five) of the customers provide general evidence as to whether customers perceive value co-creation or value co-destruction. A one-star rating reflects an extremely negative perception of the Reach Now app, a five-star rating indicates an extremely positive perception of the Reach Now app, and a three-star rating represents a middle-of-the-road perception of the app. There are two different explanations for awarding a three-star rating. First, it can reflect "a truly moderate review" (Mudambi and Schuff, 2010, p. 188), akin to indifference. Second, it can indicate a "series of positive and negative comments that cancel each other out (Mudambi and Schuff, 2010, p. 188), akin to ambivalence. The Moovel Group has frequently responded to negative customer reviews by initiating a problem-solving process. Such complaint management can lead to value co-creation for customers and for the business, but is not the focus of this work.

There are different approaches for the analysis of customer reviews, such as topic models (e.g., Büschken and Allenby, 2016; Titov and McDonald, 2008), sentiment analysis (Bagheri et al., 2013; Gonçalves et al., 2013; Laksono et al., 2019), and visual opinion analysis (Oelke et al., 2009). As highlighted by Büschken and Allenby (2016, p. 1), the challenge in analyzing customer reviews "is in understanding what the words mean. The use of the word 'hot' has a different meaning if it is paired with the word 'kettle' as opposed to the word 'car'".

As a result, analysis approaches that use predefined keywords (e.g., crash, error, and good) (Gonçalves et al., 2013), or keywords determined on the basis of word counts and frequencies (Büschken and Allenby, 2016), to identify satisfied and unsatisfied customer experiences can only reflect the actual meaning of customer reviews to a certain extent. In addition, Titov and McDonald (2008) show for topic models using the example of customer reviews for restaurants that a relatively short length of customer comments (on average 4.2 sentences) makes it more difficult to identify ratable aspects. This is a significant limitation because Reach Now app customers' comments tend to be short.

For these reasons, we decided to analyze the customer reviews provided for the Reach Now app taking a non-automated approach. We used the software NVivo 12 to store the customer reviews, which we coded in a three-stage iterative procedure (Strauss and Corbin, 1998), which is comparable to the approach followed by Sthapit and Björk

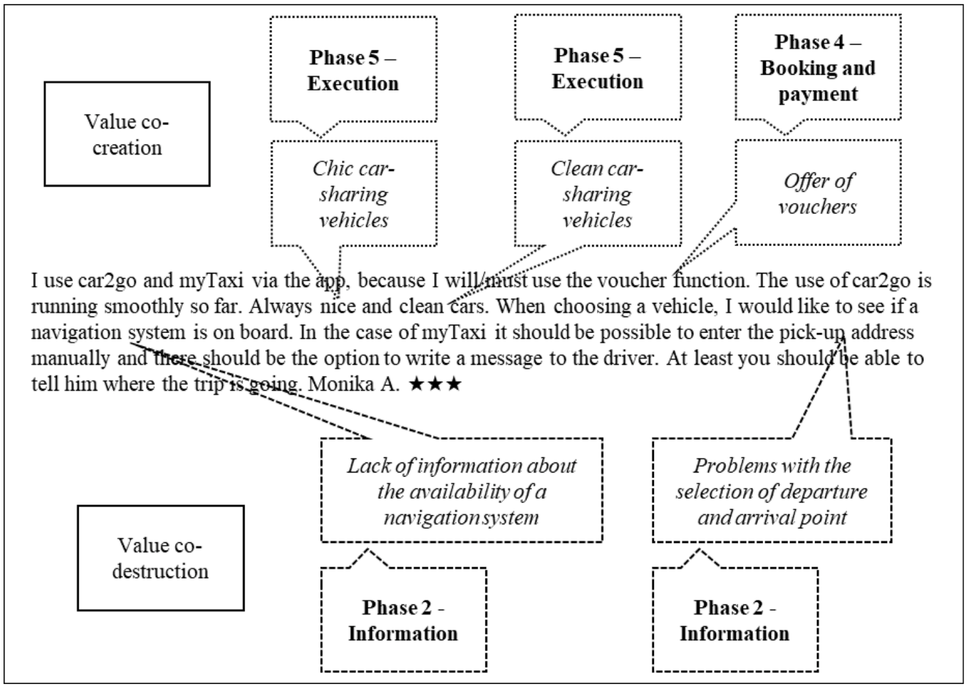

Fig. I. Coding of an exemplary customer review.

(2019) to identify the sources of value co-destruction in the case of Uber Technologies Inc.:

(1) We performed open coding in order to gain a better understanding of resource integration and service exchange between the Moovel Group and customers of its Reach Now app, and the resulting value formation. Our coding approach is based on the conceptualization that value formation is the umbrella term for value co-creation and co-destruction (Echeverri and Skålén, 2011), which represent the positive and negative outcome of resource integration and service exchange among actors. Open coding is appropriate because our knowledge about value formation, in particular value co-destruction, in actor-to-actor relationships located in a digital and mobility context is still very limited.

(1) In the analysis, the coding of the value co-creation and co-destruction that become obvious in the customer comments is performed independently of each other. To determine whether there has been an increase or decline in the well-being of the customers (i.e., whether there is value co-creation or value co-destruction), we focused on the feelings expressed and indications of the gain/loss of resources. An illustrative example for such an open coded section of a customer comment that provides empirical evidence for value co-destruction (in the form of a loss of money) is: *The amount was charged to my credit card, but I have not received the ticket. Rip-off.* Nina D ★

(2) During axial coding, we formed sub-categories, such as 'clean car-sharing vehicles' and 'problems with the selection of departure and arrival point' based on the open codes. The latter mentioned sub-category contains, for instance, the codes *in the case of myTaxi it should be possible to enter the pick-up address manually* (Monika A. ★★★) and *'Kiel central station' is already too difficult for the app. You need the exact addresses* (reqq ★). Fig. I shows the coding approach using an exemplary customer review. The axial codes are marked in italics.

(3) Finally, during selective coding, we used the sub-categories to create main categories that cover the different interactional phases from app installation to app support during the use of mobility services. For example, among others, the sub-categories 'chic car-sharing vehicles' and 'clean car-sharing vehicles' are assigned to the main category 'Phase 5 – Execution'. The selective codes are highlighted in bold in Fig. I.

3.3. Expert interviews

In order to investigate value formation in the business-to-business relationships between the Moovel Group and the mobility providers, we conducted expert interviews. Qualitative interviews are suitable due to the exploratory nature of this research (Venkatesh et al., 2013). According to Mauksch et al. (2020, p. 2) an expert is "someone who is skilful and well-informed in some special field". Expert interviews provide, among other things, the advantage of efficient data collection, as experts represent "'crystallization points' for practical insider knowledge" (Bogner et al., 2009, p. 2), and they offer access to a field that is otherwise not possible to access (Bogner et al., 2009; Myers and Newman, 2007).

Following a purposive sampling approach (Flick, 2009) aimed at identifying mobility providers with whom the Moovel Group has established an actor-to-actor relationship, we identified eleven actors on the website of the Moovel Group (Moovel, 2020) responsible for the marketing and provision of public transport services (bus, subway, tram, and/or regional train) in Germany.

These actors are four public transport companies and seven transport and tariff associations. The latter are associations of regional authorities, such as federal states, districts, or cities, which are responsible for the public transport in a geographically delimited local area, and frequently also encompass public transport companies (Reinhardt, 2012). In 2017, more than 10 billion rides were taken on German public transport (Verband Deutscher Verkehrsunternehmen, 2018), making the establishment of value co-creation between the Moovel Group and these actors an important prerequisite to ensure the satisfaction of the mobility needs of the users of the Reach Now app and of the long-term viability of the service ecosystem.

We were able to arrange semi-structured interviews with representatives from six out of the eleven public transport organizations. Semi-structured interview guidelines provide a high degree of flexibility

Table II
Overview of the interviews.

ID	Role / Function	Gender	Duration
PTO1	Project manager	Male	20 min.
PTO2	Project manager	Male	30 min.
PTO3	Project lead	Male	35 min.
PTO4	Head of department	Male	47 min.
PTO5	Head of department	Male	19 min.
PTO6	Project manager	Male	21 min.
Moovel Group	Managing director	Male	43 min.

and offer the opportunity to address issues that arise during the interviews (Flick, 2009; Myers and Newman, 2007). The managing director was chosen as contact person since s/he has knowledge about the business relationship to the Moovel Group and can help to identify possibly even better experts on this topic, such as project managers and department heads, within its organization. The interviews were conducted from October 2018 to January 2019 and lasted on average 31 min and all were recorded. Table II gives an overview of the interviews.

Slightly different interview guidelines were used for the public transport companies and the transport and tariff associations. The questions were related to the interviewee's profession, to his/her organization, as well as to the resource integration and service exchange between the organization and the Moovel Group. In line with Laud et al. (2019), our questions also focused on cases of value co-destruction where a public transport organization owns the resource required by the Moovel Group but is not willing to provide it. The selection of resources was made on the basis of scientific literature (e.g., Schulz et al., 2018; 2020c) and the preliminary results of the analysis of the customer reviews. Examples of questions include: 'Does your organization generate real-time timetable information?', 'Does your organization operate a mobile ticketing system?' and 'Do you permit Moovel Group to sell mobile tickets?'.

A semi-structured interview was also conducted with the managing director of the Moovel Group, who is positioned as an intermediary between the users of its Reach Now app and the public transport organizations and thus represents the node between the dyadic customer-to-business relationships and business-to-business relationships. Since we could not guarantee anonymization of the results, we only used this interview data to verify the statements of the other interviewees and the customer reviews. Such data triangulation improves the quality of the results (Flick, 2009; Miles et al., 2014).

The interviews were transcribed and then analyzed using the software NVivo 12. The coding was done by a member of the research team with expert knowledge in the study area and with several years of coding experience. The other researchers cross-checked the coding (e.g., Weeger and Ott-Schwenk, 2017). In addition, the emerging coding results were discussed in the research team at regular meetings in order to increase their reliability (Miles et al., 2014). In case of different interpretations of the coded data, the data was discussed as long as necessary until a common understanding was reached.

The three-stage iterative coding procedure (Strauss and Corbin, 1998) is similar to that used to analyze the customer reviews. (1) Open coding was performed on the basis of the interview transcripts to get detailed knowledge about the resource integration and service exchange between the Moovel Group and the public transport organizations, and the associated increase (decline) in well-being of public transport organizations (as evidence of value co-creation or value co-destruction). (2) On the basis of the open codes, sub-categories (e.g., 'brand damage' and 'addressing new customer groups') were created by axial coding. (3) During the selective coding stage, value formation (i.e., value co-creation or value co-destruction) in the business-to-business relationships is related to value formation in the customer-to-business relationships.

4. Results

4.1. Value co-creation and co-destruction in customer-to-business relationships (Reach Now app user-to-Moovel Group relationships)

On an aggregate level, the star ratings (one to five) assigned by the users to the Reach Now app (originally named Moovel app) provide information about whether the users perceived value co-creation or value co-destruction based on resource integration and service exchange. Of the 506 customer reviews, 294 have a one- or two-star rating. Hence, the majority of the customer reviews provide evidence of value co-destruction often indicated by the additional expression of negative feelings, such as anger and dissatisfaction. A detailed analysis of the customer comments shows how the (inadequate) integration of different single resources – subsequently highlighted in bold letters – and the subsequent service exchange leads to value co-creation (value co-destruction) from the customer perspective.

The customer reviews of the Reach Now app and of the recommended mobility services *are very individual*. As can be seen from the following exemplary customer reviews, the provision of discounts for public transport on days with high particle pollution level warnings (**special ticket**) often caused value co-creation as a monetary benefit is achieved. However, in some cases, also value co-destruction because the users are annoyed and frustrated that they did not win a ticket:

> *Thank you, Mr. Daimler! A few years ago, I wouldn't have thought that such a great offer, of course especially the 50/50 chance of winning the ticket on days with particle pollution level warnings (…) is possible. Of the seven trips I took in the Verkehrs- und Tarifverbund Stuttgart [transport and tariff association], four were paid for, two of them were 7 zone tickets.* A Google-user ★★★★★

> *Cheating at the particle pollution lottery? I have so far bought 8 single tickets during the particle pollution level warnings in Stuttgart and won one of them – according to my calculations a 12.5% ratio. Moovel Group advertises a 50:50 chance. It is extremely unlikely that my chances are so unequal. Have other users had similar experiences?* A Google-user ★

In accordance with the theoretical foundations of the S-D logic perspective, the detailed analysis of the customer reviews shows that the different resources lead to value co-destruction or value co-creation on the part of the Reach Now app users in the different interactional phases of the customer-to-business relationships (e.g., installation, registration and log-in, information). An overview of the value formation in each phase and the resources responsible, is provided in the Appendix (Table IV to XV). In the following, we each present the three most important resources that caused value co-creation, respectively, value co-destruction.

Two out of the three cases concerning *value co-destruction* can be assigned to the booking and payment phase. 49 users of the Reach Now app complained about booking and payment errors (**app**; phase 4), indicating insufficient resource integration and service exchange by the Moovel Group. As can be seen from the following exemplary customer review, there is not only value co-destruction that is reflected by negative feelings (e.g., anger, dissatisfaction, and frustration), but also a loss of money:

> *I had double bookings because the app reported that the booking could not be completed. So I did the booking again and suddenly had two identical bookings with two tickets each.* Stefan G. ★★★★

The fact that no ticket sale for public transport (**mobile tickets**; phase 4) is currently offered directly in the Reach Now app resulted in value co-destruction for 39 users. As a result, users had to, for example, spend additional time downloading a second app and completing the registration to obtain tickets:

Now I was redirected to the next app (SSB Best Price) when buying a ticket, where a new registration, etc. was necessary. This means that the core benefit for me of being able to use everything with one app is completely lost (that was the only benefit so far). A pity. Andreas Matera ★★

Formerly, a great app! In Hamburg you suddenly can't buy Hamburger Verkehrsverbund [the transport and tariff association] tickets for public transport anymore. Before the update, this was a great app. But now it is useless for me. Michael Krieg ★

The two customer reviews reveal that there was a change over time in terms of resource integration and service exchange by the Moovel Group. Similar changes were also observed with regard to the type and number of payment methods implemented.

Our analysis shows that there was value co-destruction for 40 users, such as loss of time and financial disadvantage, caused by Reach Now app crashes (**app**; phase independent). For example:

It just doesn't work. I spent an hour going from error to error and crash to crash until I was finally ready to buy a ticket. After I pressed the buy button, you might have guessed it, it came to an error. I tried two more times – nothing! I give up and will buy via the Verkehrs- und Tarifverbund Stuttgart [the transport and tariff association] at double price ☹ Heiko Schneider ★

The crashes of the Reach Now app occurred during all interactional phases. While the value co-destruction resulting from the lack of ticket sales indicates an underlying lack of resource integration and service exchange by the public transport organizations, the booking and payment errors as well as the crashes of the app are the responsibility of the Moovel Group.

The customer reviews also provide insights into the resource integration and service exchange that lead to *value co-creation* for the users of the Reach Now app. In the case of 24 users, the discounts offered for the public transport services on days with particle pollution level warnings in the geographical area of the transport and tariff association Stuttgart (**special ticket**; phase 4) result in value co-creation.

In addition, the high stability (23 users) and the good functional design (20 users) of the Reach Now app (**app**; phase independent) lead to value co-creation for users. For example, in the form of a time-efficient use of the Reach Now app.

Wonderful, just great. I've been using Moovel for a few months now. It is super. Everything works just fine. A Google-user ★★★★★

I like this app. It is chic, has an efficient user workflow and does what it is supposed to do. Udo Bussmann ★★★★★

As the results show, value co-creation currently often takes place in cases when the Reach Now app fulfills the basic requirements placed on it. Value co-creation related to the provision of high quality recommendations or simple booking and payment across several mobility services as possible differentiating features of apps such as the Reach Now app are of relatively minor importance.

4.2. Value co-creation and co-destruction in customer-to-business-to-business relationships (Reach Now app user-to-Moovel Group-to-public transport organization relationships)

By conducting expert interviews, we analyzed the value formation in the business-to-business relationships between the Moovel Group and the public transport organizations. We focused on identifying the causes for the resource integration and service exchange (as well as the related value formation) that we observed for the customer-to-business relationships between the users of the Reach Now app and the Moovel Group described in the previous section. Our analysis shows that empirical evidence can be provided for all four possible links of value formations between the two dyadic actor-to-actor relationships.

4.2.1. Value co-creation - Value co-creation

The provision of different information**,** such as travel times and prices, about multiple mobility services (**information**; phase 2) by the Reach Now app creates value for users (e.g., shorter travel times, lower costs, and fewer transfers). The satisfaction about the provision of information can be seen from the following exemplary customer review:

SUPER! Uniquely good! There's a lot more information provided than I thought. I am really excited – Thanks for this app! Peter Pommerencke ★★★★★

The wide dissemination of information through the Reach Now app, especially of travel times, also leads to value co-creation for the public transport organizations. It is not surprising that the interviewees see the potential to gain new customers, such as private car drivers, for their public transport service – "*For us, that is marketing*" (PTO4). In addition, the transfer of (high-quality) information to third parties, such as the Moovel Group, ensures that the same information is provided to (potential) customers across all information channels:

"We want to strengthen the public transport. Therefore, we use as many media channels as possible. (…). This is also an added value when the customer can use different portals and always receives the same information, which always originates from our system." (PTO6)

Furthermore, the Reach Now app can help the public transport organizations to provide information about their mobility services in a more attractive and user-friendly way to customers:

"*Of course, we also offer apps and online shops. But I could imagine that there are solutions that are perhaps even smarter and more customer-friendly. (…). I could imagine that if there is, for example, a large [service] platform, it would be able to adapt the offers much better to the customer. Using artificial intelligence to make recommendations to the customer, which make more sense for her/him than this standard offer that, for instance, we would offer."* (PTO1)

Especially in cases where public transport connections are poor, customers can use the Reach Now app to access information on how to reach their destination without a private car (PTO5). Thus, by providing information about their services that can be bundled with other mobility services, public transport organizations can make their service offer more attractive, which leads to more customers and earnings.

The offer of discounts (**special ticket**; phase 4) also initiates value co-creation in both dyadic actor-to-actor relationships. As quoted above, one user of the Reach Now app wrote:

Thank you, Mr. Daimler! A few years ago, I wouldn't have thought that such a great offer, of course especially the 50/50 chance of winning the ticket on days with particle pollution level warnings (…) is possible. Of the seven trips I took in the Verkehrs- und Tarifverbund Stuttgart [transport and tariff association], four were paid for, two of them were 7 zone tickets. A Google-user ★★★★★

In addition, offering discounts is associated with a value co-creation for the public transport organizations, as their public transport services become more attractive for non- and infrequent users. This can contribute to solving the problems caused by the predominant use of private cars, which is, in particular, a concern of the regional authorities involved in the public transport organizations:

"The topic high particle pollution [discount] is aimed primarily at occasional customers who should switch to bus and train. The subscription customers who have the regular discount are already users. (…). But in the case of particle pollution level warnings, individual trips should be avoided. It is a matter of making an offer to the user of the individual motorized transport, where s/he has a significant monetary advantage

and, as a result, takes the bus and train and leaves the car parked." (PTO2)

4.2.2. Value co-creation - Value co-destruction

In addition, we have identified cases where resource integration and service exchange caused value co-creation in the relationship between the users of the Reach Now app and the Moovel Group, but value co-destruction in the relationship between the Moovel Group and the public transport organizations. Users appreciate, for example, that the Reach Now app can be used as single access point for the purchase of a number of mobility services (**app**; phase 4), as illustrated by the following customer review:

Everything in one app, with only a few clicks to book. This is really practical. Robert Wolf ★★★★★

In other words, users can save time and effort when booking different mobility services by using the Reach Now app. On the other hand, the simplified access to various mobility services leads to value co-destruction for the public transport organizations (e.g., higher distribution costs) as they lose direct access to the customers:

"(…) simply for the reason to keep access to customers and not to fall into dependence on these intermediaries. In the hotel sector or in the case of travel platforms, one can already see that [companies, such as] the HRS Group, can sometimes charge commissions that nobody can defend themselves against." (PTO3; see also PTO1)

For the public transport organizations, however, value co-destruction occurs not only due to potential overcharging, but also the value of their brand may decrease due to the loss of direct customer contact:

"With the [name of the app], for example, we have a coverage range of over 90 percent that is one of the highest ranges of coverage of all mobility providers here in the region and much more than other apps for public transport combined. This is because the [name of the transport and tariff association] has built up a brand over decades and the customer has always understood the [name of the transport and tariff association] as the first point of contact. Everything that newly introduced to the market is entering a saturated market and must fight for its market position and poach customers accordingly." (PTO2)

4.2.3. Value co-destruction - Value co-creation

As can be seen from the following exemplary customer review, value co-destruction takes place because there is currently no ticket sale for public transport (**tickets**; phase 4) directly via the Reach Now app. As a result, users have to purchase tickets, for example, from the bus driver or by using a ticketing machine, which leads to a loss of time. Alternatively, they can install and use a second app, but this causes complexity and a high cognitive effort.

To buy a ticket, you now have to install another app – that is awful! It is called 'all-in-one mobility app'! But the strangest thing is: Many people complain here that you can't buy tickets anymore and that you need another app since the update. Moovel Group replies succinctly that since the update ticket purchases are not longer possible, but there is another 'great app' for ticket purchase. Yes, that is exactly the point being criticized! I have no idea what that's good for. A pity. Uninstalled. Saša Vrabac ★

However, also the fact that not all ticket types (**tickets**; phase 4) were sold before the update caused value co-destruction for users as the cheapest tickets in their specific case were not available:

The only problem is that you cannot book daily tickets (but due to the absurd single ticket prices they are the better option here in Stuttgart). If these tickets were available, you'd get 5 stars! TheHennes36 ★★★★

While the lack of (direct) sales of tickets leads to value co-destruction for the users of the Reach Now app, the public transport organizations can realize value co-creation. After the update, users are still able to indirectly purchase (as least some of) the tickets, while the public transport organizations ensure that their own distribution remains attractive, which makes overcharging more difficult and ensures the availability of tickets for the entire geographical area, as expected by the regional authorities:

"(…) of course, there is also the danger that platforms sell our tickets, but charge a 30 percent commission. In this case, it helps us relatively little if we, for example, can attract 10 percent more customers but have to pay a 30 percent commission." (PTO1)

"(…) that is a problem, you see it quite often, for example, in Berlin. There are mainly start-ups that try to sell tickets for the Berliner Verkehrsbetriebe or the Verkehrsverbund Berlin-Brandenburg, (…), and they mostly limit the ticket distribution to the inner railway ring of Berlin, but that is not our claim. Our claim is to sell tickets for the entire geographical area of the [name of the transport and tariff association]. That is not quite as simple as it is for only one city, because there are special features in the tariff." (PTO1)

Further value co-creation for public transport organizations arises as other ticket media can continue to be used for specific tickets, which among other things reduces the costs caused by misuse:

"(…) the [name of the smartcard] is the access medium for subscription customers. Because the smartcard offers a certain degree of security and has a long shelf life, the more expensive tariff products (time tickets) are provided on it. For occasional customers (…) it is better to offer a mobile ticket so that they do not have to get a smartcard first. In comparison, in the case of misuse, the loss is of course not as high as in the case of the smartcard." (PTO2)

4.2.4. Value co-destruction - Value co-destruction

The lack of provision of real-time information (**information**; phase 2) in the Reach Now app is associated with value co-destruction in both dyadic actor-to-actor relationships. As illustrated by the following customer review, one user is angry about the provision of incorrect timetable information:

WRONG timetables like those here are worse than no timetables! A Google-user ★

The lack of real-time timetable information not only leads to user dissatisfaction with the Reach Now app, but the mobility services offered by the public transport organizations also become less attractive. As a result, more people will use their private car, which leads to negative effects for the society (e.g., air and noise pollution, which is especially noticeable in cities). On the other hand, due to the lack of real-time data (PTO6), the public transport organizations also cannot improve their capacity management, for example during rush hour, by marketing their services via the Reach Now app:

"(…) as long as there are no reliable availability forecasts, it is uncertain whether I should advise people to get off the train at a certain stop because they might not find a car-sharing car." (PTO4)

Furthermore, value co-destruction takes place in both actor-to-actor relationships with regard to customer data (**data**; phase independent). The following customer review shows that users of the Reach Now app currently do not understand why the collection and analysis of data, such as of the departure and arrival points, as well as the preferences in the choice of mobility service bundles, is important:

But the app is definitely using too much data without any clear benefit. This looks too much like a data leech to me. Markus Sortis ★★

Table III
Examples of value formations in customer-to-business-to-business relationships.

Case	Customer-to-business relationships	Business-to-business relationships	Exemplary resources	Description
1	Value co-creation	Value co-creation	Information, special ticket	Provision of information about mobility services (e.g., travel times and prices), provision of discounts on days with particle pollution level warnings
2	Value co-creation	Value co-destruction	App	Provision of a single access point for a number of different mobility services
3	Value co-destruction	Value co-creation	Tickets	No ticket sale, no sale of all ticket types
4	Value co-destruction	Value co-destruction	Information, data	No provision of real-time information, no provision of customer data (e.g., route requests)

The value co-destruction as perceived on part of the users is caused by the high fragmentation of customer data between the Moovel Group and the public transport organizations, and their desire to have control over this resource, which makes the use of a big data approach more difficult:

> *"(…) the Moovel Group is the boss that has data sovereignty. In other words, they have encapsulated the data in terms of customer and mobility data. What we receive are sales invoices (that customers have booked). But we don't get any data about which routes were taken, for example with a car-sharing car, or what the requests and bookings look like. We don't have this information."* (PTO3)

The lack of dissemination of information obtained at a higher level prevents public transport organizations from gaining a better understanding about the mobility behavior of the current users of the Reach Now app. As a result, possible obstacles for using public transport, such as a high number of transfers and long waiting times cannot be taken into account when drawing up timetables, which in turn make the service less attractive for customers and also for current non-users. Table III summarizes the results of our analysis focusing on the link between the value formations in the dyadic customer-to-business relationships and the business-to-business relationships that are embedded in the service ecosystem of the Moovel Group.

5. Discussion

5.1. Theoretical implications

This article contributes theoretically by *mitigating the value "co-creation myopia"* (Plé, 2016, p. 154), which currently prevails in research adopting the S-D logic perspective as a theoretical lens. Most previous studies (e.g., Lusch and Nambisan, 2015; Vargo and Lusch, 2004), including those with a mobility context (e.g., Hein et al., 2018; Schulz et al., 2020a; Turetken et al., 2019), consider the concept of value co-creation but fail to consider the concept of value co-destruction (e.g., Laud et al., 2019; Leroi-Werelds, 2019; Plé, 2017; Plé and Cáceres, 2010; Prior and Marcos-Cuevas, 2016). This applies in particular to the IS field, as evidenced by the results of a search in the electronic library AISeL showing 629 articles considering value co-creation, but only 15 articles considering value co-destruction.

In other words, the S-D logic literature is slanted toward or presumes positive outcomes (value co-creation) of the resource integration and service exchange among actors of a service ecosystem and underplays or disregards negative outcomes (value co-destruction). Based on this limitation, earlier works only provide fragmented insights into the emergence and long-term viability of a service ecosystem such as that of the Moovel Group.

In contrast, this study considers both value co-creation and co-destruction among different actors of the service ecosystem of the Moovel Group. In line with Echeverri and Skålén (2011), we use the term 'value formation' as an umbrella for the value co-creation and co-destruction that take place during resource integration and service exchange. Following the approach of several scholars (e.g., Dolan et al., 2019; Frau et al., 2018; Yin et al., 2019), we analyzed customer reviews provided for the Reach Now app to gain insights into the value formation in the customer-to-business relationships between the app users and the Moovel Group.

Our results point to extensive value co-destruction evidenced by app users' negative feelings, such as anger and frustration, and a loss of resources (e.g., time and money) that can lead to the termination of the

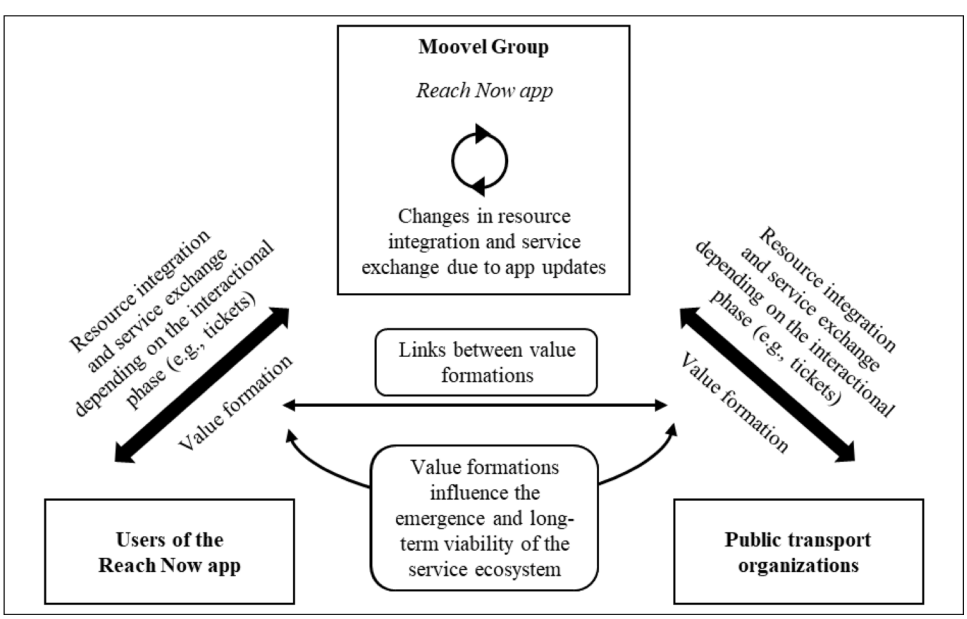

Fig. II. Interactional phase-based perspective on the IT-enabled value formations in a tripartite relationship of a service ecosystem.

Table IV
Value co-destruction in phase 1 – Installation, registration and log-in.

	Value co-destruction	Resource	Number of customers	Exemplary customer review
Phase 1 – Installation, registration and log-in	Problems with log-in	App	35	The app wouldn't open this morning in the subway… I was sent back to the log-in page over and over. When I was asked to show my ticket, I was told I had to pay a 60 Euro penalty. In the end, I had to pay a 7 Euro handling fee, after I had a lot of trouble getting my ticket to come up… I am really angry about this app!
	Problems with registration	App	12	What a bunch of crap! I have been waiting for over 30 min for the confirmation mail to complete my registration! No THANK YOU – if it's that much trouble right at the beginning, better steer clear of it! App deleted! Put it in the trash, where it belongs!
	Problems with editing user profile	App	4	Bad, if you change your email address you lose all of your customer data. Great if the train is just arriving (this connection comes every 20 min) and you notice that no payment option has been saved!!! Thanks, really great ☹
	Problems with validating driver's license	App	3	Unfortunately, the driver's license scan failed again and again, despite a lot of patience. So car-sharing does not work with the Moovel-app [now called Reach Now], which makes the app useless for me.
	Problems with installation	App	2	Cannot be installed. Unfortunately, the new version cannot be installed, error 504. Too bad, I was a customer from the very beginning :-(
	Unsolicited installation	App	1	How audacious, the app wants to install itself without being asked.
	Complex general terms and conditions	General terms and conditions	1	Finally, I would like to mention that for my taste the general terms and conditions are so opaque and long that I will not study them. Since I have to agree to them to use the app, it will be deleted. It is actually a pity, because I found the approach quite ok.
	No crediting of bonus points	Bonus points	1	Unfortunately, the TVSmiles were not credited accordingly!!
	Unsolicited advertising	App	1	Dubious, adware-like advertising. Opens the Playstore page directly from the browser without clicking. Such apps should be banned from the Playstore! Simply audacious, such 'advertisements' that border very strongly on adware. Shame.
	No provision of a fingerprint ID	App	1	The integration of the fingerprint ID from Android would be great.

Table V
Value co-destruction in phase 2 – Information.

	Value co-destruction	Resource	Number of customers	Exemplary customer review
Phase 2 – Information	Problems with the selection of departure and arrival point	App	32	But now it is useless. Search queries with names are unclear or wrong in 80% of the cases. 'Kiel central station' is already too difficult for the app. You need the exact addresses and even these are difficult for the app to find.
	Lack of information on mobility services	Information	22	Very little car-sharing. Nextbike would be fine, but then I'll simply use their app.
	Inadequate information on travel times	Information	8	WRONG timetables like those here are worse than no timetables!
	Incorrect price information	Information	5	Car2go price information without taking into account the airport fee and the drop off fee, thus the double price was charged after use. Very questionable practice.
	Lack of information on the location of car-sharing vehicles	Information	3	BUT: Why aren't all the car2go vehicles displayed that car2go displays in its own app? It happens again and again and again that Reach Now does not display all vehicles. In addition, free spaces at the charging stations are not reliably displayed. In the car2go-app they are always correct, I have seen this for several weeks at the charging station in front of my door.
	Lack of price information	Information	2	Why am I not given an overview of the costs of each means of transport?
	Problems with selection of departure and arrival time	App	1	The departure and arrival time can also not be changed properly. How can you mess it up like that?
	Lack of information about availability of a navigation system	Information	1	When choosing a vehicle, I would like to see if a navigation system is on board.

relationship. One user, for instance, was annoyed because he had to pay a high penalty for fare evasion due to log-in problems. He ultimately had to pay the handling fee. In addition, our analysis illustrates that value co-destruction (similar to value co-creation) occurs at all interactional phases of the customer-to-business relationships (e.g., installation, registration and log-in phase, information phase). In summary, this study is a (further) call to researchers to focus on the full spectrum of value formation in order to provide a more nuanced understanding of the emergence and long-term viability of a service ecosystem.

Secondly, we contribute to the S-D logic literature that focuses on *IT-enabled value formation in dyadic actor-to-actor relationships* embedded in a service ecosystem, especially in service ecosystems, in a *mobility context*. Although the S-D logic perspective is a well-established theoretical lens that has been applied in various research fields (for an overview, see Vargo and Lusch, 2017), many scholars (e.g., Blaschke et al., 2019; Breidbach and Maglio, 2016; Breidbach and Ranjan, 2017; Haki et al., 2019; Kim et al., 2018) point out that the knowledge about IT-enabled value co-creation is very limited. In addition, since the concept of value co-destruction is rarely considered in scientific research (e.g., Laud et al., 2019; Leroi-Werelds, 2019; Plé, 2017) there also is a lack of understanding about IT-enabled value co-destruction.

This general picture is confirmed by our review of the S-D logic literature that focuses on the value formation among actors in a mobility context (see Table I). First, our overview shows that there are very few studies in this research area. Some previous studies analyzed value co-creation and/or value co-destruction in dyadic *customer-to-business relationships* (e.g., Echeverri and Skålén, 2011; Gohary et al., 2016; Sthapit and Björk, 2019). The underlying resource integration and service

Table VI
Value co-destruction in phase 3 – Optimization and recommendation.

	Value co-destruction	Resource	Number of customers	Exemplary customer review
Phase 3 – Optimization and recommendation	Lack of connections between departure and arrival point	App	35	MyTaxi app. The developer of this app is obviously sponsored by myTaxi. Not one public transport connection is shown. Not even if the start and arrival point are right next to stops.
	Poor quality recommendation	App	18	Apparently not mature. I wanted to organize a trip from a Duisburger district to Duisburg central station. In a radius of 500 m around my location, there are three different bus lines and one tram connection to get to the destination. The travel time using the tram is 9 min, with the bus 30 min for 2,60 Euro in each case. The recommended trip is a taxi for (approximately) 16 Euro. Conclusion: Uninstall.
	Lack of individualization	App	10	Unfortunately, only the shortest connection is displayed. Sometimes I want to make a little detour to meet friends. This is not possible with the app. It is also not possible to specify via settings that only train travel should be searched for. Please improve it. For these reasons, I currently cannot use the app.
	Poor display of recommendations	App	9	Time comparisons between car2go, public transport, and taxi are no longer available. What a pity. This was once a very well-thought-out app.
	No link to the diary	App	1	It is not possible to export the travel times to my calendar.

Table VII
Value co-destruction in phase 4 – Booking and payment.

	Value co-destruction	Resource	Number of customers	Exemplary customer review
Phase 4 – Booking and payment	Errors in booking and payment	App	49	I had double bookings because the app reported that the booking could not be completed. So I did the booking again and suddenly had two identical bookings with two tickets each.
	No sale of tickets	Tickets	39	To buy a ticket, you now have to install another app – that is awful! It is called 'all-in-one mobility app'! But the strangest thing is: Many people complain here that you can't buy tickets anymore and that you need another app since the update. Moovel Group replies succinctly that since the update ticket purchases are not longer possible, but there is another 'great app' for ticket purchase. Yes, that is exactly the point being criticized! I have no idea what that's good for. A pity. Uninstalled.
	Lack of a payment method	App	23	After the cancelation of the SEPA direct debit procedure as a payment option, I canceled my account! Credit card is the only possible option. I have never experienced customers being treated so harshly and inconsiderately.
	No sale of entire range of tickets	Tickets	14	The only problem is that you cannot book daily tickets (but due to the absurd single ticket prices they are the better option here in Stuttgart). If these tickets were available, you'd get 5 stars!
	No provision of discounts	Special ticket	9	Cheating at the particle pollution lottery? I have so far bought 8 single tickets during the particle pollution level warnings in Stuttgart – and won one of them – according to my calculations a 12.5% ratio. Moovel Group advertises a 50:50 chance. It is extremely unlikely that my chances are so unequal. Have other users had similar experiences?
	No consideration of subscriptions and other certificates	Special ticket	7	However, you should also be able to enter: I am a BahnCard owner, I am a pensioner, and also if you have a disability certificate.
	Lack of information at booking and payment	Information	5	Taxi reservation. I booked a taxi last night for an airport ride on Sunday. Now under 'future trips' 'reservation started' is shown and that's it. More information or cancelation, I don't know how. Is my requested taxi coming or not? :(

exchange take place either in a face-to-face (e.g., Echeverri and Skålén, 2011; Gohary et al., 2016) or digital environment (Sthapit and Björk, 2019; Yin et al., 2019, etc.). However, there are currently no studies on the value formation in dyadic customer-to-business relationships embedded in a service ecosystem such as that of the Moovel Group, where a variety of mobility services are accessible through an app.

Furthermore, only a few S-D logic studies have examined value formation in dyadic *business-to-business relationships* in a mobility context. Previous studies that focused on the IT-enabled value co-destruction are limited because only cases with an entire lack of resource integration and service exchange among actors were analyzed (e.g., Schulz and Überle, 2018; Zimmermann et al., 2020). In addition, the scientific research that used both the value co-creation and the business model concept does not provide detailed insight into the integration of specific resources (e.g., an app) and the subsequent service exchange (Gilsing et al., 2018; Hein et al., 2018; Turetken et al., 2019). In summary, our review on the value formation in dyadic actor-to-actor relationships that are located in a mobility context provides a synthesized knowledge base on which future research can be built. In particular, it reveals a major research gap with regard to the IT-enabled value formation among actors.

We contribute to closing the identified research gap by analyzing the customer reviews provided for the Reach Now app in the Android Google Play Store between 2016 and 2019. Based on our analysis, we provide a holistic perspective on resource integration, service exchange and value formation in the different interactional phases of the customer-to-business relationships that are embedded in the service ecosystem of the Moovel Group (see Tables IV to XV in the Appendix). Our results offer quantitative insight into which resources are most important for value co-creation and co-destruction from the perspective of the app users, and thus on which future research should focus in order to ensure its practical relevance. For example, the provision of discounts for public transport on days with particle pollution level warnings is one of the main sources of value co-creation in the case of the Reach Now app. With these results, we complement previous work (Albrecht and Ehmke, 2016; Willing et al., 2017a; 2017b) that provides a comparison of apps and browser solutions similar to the Reach Now app, but without analyzing the value formation on the part of users (i.e., not taking the

Table VIII
Value co-destruction in phase 5 – Execution.

	Value co-destruction	Resource	Number of customers	Exemplary customer review
Phase 5 – Execution	Poor navigation	App	4	Has not be improved. It is okay! Almost every train and bus stop has two directions. In the display, however, you can't figure out which direction you should go. The final stop is of no use at all. Especially, if you are unfamiliar with the area. This is important.
	No taxi cancelation	App	2	After 20 min waiting time and often changing departure time forecasts, myTaxi in Berlin did not arrive after all. Unfortunately, there is no cancelation button. I'm getting a private ride now.
	Error in opening the car-sharing vehicle	App	2	The Flinkster vehicles cannot be opened. I have tried several times to book and open vehicles via the app today. The reservation worked perfectly, but when I stood in front of the vehicle nothing happened…After long phone calls with the Flinkster hotline I was able to get help after 20 min. Please get on this quickly and see what is going on.
	Failure of the mobility service	Taxi vehicle	1	After 20 min waiting time and often changing departure time forecasts, myTaxi in Berlin did not arrive after all.
	Lack of information about bike-sharing	Information	1	For example, you can rent a Nextbike. But it is not written anywhere that the code is for the bike lock and not for the computer. And there is no explanation how to return the bike.
	Lack of information about public transport	Information	1	Platform information would be very helpful, especially at large stops or stations.
	Charging card defective (car-sharing)	Charging card	1	Car2go used. Charging card defective, Moovel Group not reachable. Car2go-hotline cannot help. I had to pay twice as much as necessary because of waiting time. Never again.
	No reward for charging the car-sharing vehicle	Reward	1	Rewards for charging car2go-vehicles are not credited.

Table IX
Value co-destruction – Phase independent.

	Value co-destruction	Resource	Number of customers	Exemplary customer review
Phase independent	App crashes	App	40	It just doesn't work. I spent an hour going from error to error and crash to crash until I was finally ready to buy a ticket. After I pressed the buy button, you might have guessed it, it came to an error. I tried two more times – nothing! I give up and will buy via the Verkehrs- und Tarifverbund Stuttgart [the transport and tariff association] at double price ☹
	Poor functional design	App	16	Cumbersome and confusing to use.
	Poor performance	App	15	In addition, searching for connections for simple 15-min routes takes over 30 s (even with WLAN).
	Poor customer service	Staff	13	Service is almost non-existent. The contact via Twitter was very friendly and helpful, but couldn't help either, because the people responsible were already at the end of the working day.
	Low level of data protection	Data	12	But the app is definitely using too much data without any clear benefit. This looks too much like a data leech to me.
	Server connection problems	App	8	Connection?? If the connection exists, it works quite well but unfortunately the server seems to go down very often. The app is thus hardly usable.
	High data volume consumption	App	7	For four bookings 317 MB data transfer, there is something wrong!!!
	High battery consumption	App	4	Unfortunately, it is currently draining the battery, although I did not use it and even forced a stop. So it is uninstalled.
	No added value	App	3	Where is the added value compared to Google Now? I was curious because of all the advertising and I am disappointed. I don't see any added value compared to Google Now (except the information about the expected fare) – I already have the car2go-app – why should I use this app? I don't understand the concept.
	Poor visual design	App	3	Otherwise only the pale background color disturbs me.
	No offline use	App	1	A great app, but unfortunately you always have to be connected to the Internet. It would be great if the app could also be used offline.
	Not for disabled persons	App	1	I am unfortunately hearing-impaired, I cannot use everything.

S-D logic perspective).

In addition, our analysis of the customer reviews provided for the Reach Now app highlights the importance of app updates for the understanding of changes in value formation in the customer-to-business relationships over time. Usually, software updates are performed to improve the functionality and operational reliability, and to close security gaps, which lead to higher value formation for users. However, our results depict that the Moovel Group has also used updates to reduce the functionality of its Reach Now app. Several user experienced value co-destruction after updates if, for instance, public transport tickets can no longer be purchased directly in the app or the range of payment methods (e.g., SEPA direct debit, Paypal) is narrowed. In other words, the Moovel Group has used updates to change resource integration and service exchange among actors, and thus the value formation in the customer-to-business relationships. Accordingly, S-D logic research should focus on updates to study changes in value formation over time and related topics such as the termination of relationships.

Lastly, we contribute to the S-D logic literature by providing an understanding *how the IT-enabled value formations in different dyadic actor-to-actor relationships of a service ecosystem are linked.* Almost all previous studies (e.g., Blaschke et al., 2019; Breidbach and Maglio, 2016; Laud et al., 2019; Rahman et al., 2019; Sigala, 2018) – in line with the research gap that we identified for studies with a mobility context – only examine the IT-enabled value formation in single dyadic actor-to-actor relationships in a service ecosystem. This results in limited insights into the emergence and long-term viability of service ecosystems. In order to complement our results for value formation in the customer-to-business relationships, we conducted interviews with experts from the Moovel Group and German public transport organizations to gain knowledge about value formation in the business-to-business relationships.

Our analysis of the link between the value formations in both dyadic

Table X
Value co-creation in phase 1 – Installation, registration and log-in.

	Value co-creation	Resource	Number of customers	Exemplary customer review
Phase 1 – Installation, registration and log-in	App is free of charge	App	1	It costs nothing!!!
	Driver's license validation	App	1	The validation of the driving license is great. Everything can be done easily online.
	Free driver's license validation	App	1	The validation of the driving license is great. Everything can be done easily online and even free of charge. In contrast, in the case of car2go, you have to pay 9 Euro.

actor-to-actor relationships shows, for instance, that the lack of integration of all ticket types by the public transport organizations leads to value co-destruction between the Moovel Group and the users of its Reach Now app, because the users have to buy certain tickets from the bus driver or install and use a second app (e.g., loss of time, high cognitive effort and complexity). On the other hand, the public transport organizations sell certain tickets via the Reach Now app generating monetary value, and by preventing the sale of other tickets, also ensure that their own distribution remains attractive, which leads to lower costs of distribution and makes overcharging by the Moovel Group more difficult (i.e., value co-creation). The integration of a specific resource (here: certain ticket types) by the public transport organizations thus leads to different value formations in both analyzed dyadic actor-to-actor relationships. Overall, our results provide empirical evidence that all four links between value co-creation and co-destruction occur in practice (see Table III).

In summary, our study helps to better understand IT-enabled value formations (that take into account both value co-creation and co-destruction) among different actors of a service ecosystem, and thus of its emergence and long-term viability by shedding light on the resource integration and service exchange in the tripartite relationship between the Moovel Group, users of its Reach Now app, and German public transport organizations. Fig. II exhibits our interactional phase-based perspective on IT-enabled value formations in a tripartite relationship of a service ecosystem such as that of the Moovel Group.

5.2. *Practical implications*

This study makes several practical contributions. First, smart mobility app providers can apply the findings of our work *to improve their apps* and thus to enable a simpler and more convenient use of several mobility services during a trip. The results are particularly valuable for start-ups which, unlike the Moovel Group, are not subsidiaries of well-established companies (Albrecht and Ehmke, 2016) and are often subject to financial and personnel constraints. Our findings go well beyond current rather superficial comparisons of the different apps and browser solutions available to practitioners (Albrecht and Ehmke, 2016; Willing et al., 2017a; 2017b) by taking the customer perspective into account. Our analysis of customer reviews that were provided for the Reach Now app offers deeper insights into user needs at all interactional phases of the customer-to-business relationships, ranging from the app installation and registration to the app-supported execution of the trip. For example, many users complained that it is not possible to buy a (specific) public transport ticket and about the limited payment options available.

In addition, our study points out to the need to improve and stabilize the Reach Now app technically to prevent crashes, solve log-in problems, as well as prevent booking and payment errors. Better understanding user needs and eliminating technical shortcomings can make using apps such as the Reach Now app more attractive for current and potential users. This, in turn, can contribute to a shift in the mobility behavior of individuals from private car use to the use of different mobility services, such as public transport, and car- and bike-sharing. A decrease in private car use helps to address problems such as time wasted waiting in traffic or looking for parking, as well as air and noise pollution, which are commonplace in cities around the world (Schreieck et al., 2018; Willing et al., 2017a; 2017b).

Secondly, we contribute to *the emergence and long-term viability* of

Table XI
Value co-creation in phase 2 – Information.

	Value co-creation	Resource	Number of customers	Exemplary customer review
Phase 2 – Information	Information on mobility services	Information	6	Top app, with a good range of mobility providers.
	Information on travel times	Information	3	But it is very nice that you can always see when the train is going to arrive. Kudos to you. THANK YOU. Best regards, Lilli Lilli.
	Information (general)	Information	3	SUPER! Uniquely good! There's a lot more information provided than I thought. I am really excited – Thanks for this app!
	Provision of price information	Information	1	Only once did Moovel Group and the Verkehrs- und Tarifverbund Stuttgart [the transport and tariff association] quote different prices for the same route. Moovel Group offers a price that is one zone cheaper, the Verkehrs- und Tarifverbund Stuttgart the more expensive price. I wrote to the Verkehrs- und Tarifverbund Stuttgart and asked for clarification. The Verkehrs- und Tarifverbund Stuttgart said that both prices are correct. How about that. The Verkehrs- und Tarifverbund Stuttgart just provides the more expensive price information.

Table XII
Value co-creation in phase 3 – Optimization and recommendation.

	Value co-creation	Resource	Number of customers	Exemplary customer review
Phase 3 – Optimization and recommendation	High-quality recommendation	App	9	I use the app primarily in Stuttgart and there it is much better, especially regarding the connections, than the Verkehrs- und Tarifverbund Stuttgart [the transport and tariff association] app.
	Good display of recommendations	App	6	A very good app. It always shows the fastest and easiest connection, also considering car2go.

Table XIII
Value co-creation in phase 4 – Booking and payment.

	Value co-creation	Resource	Number of customers	Exemplary customer review
Phase 4 – Booking and payment	Offer of discounts	Special ticket	24	Thank you, Mr. Daimler! A few years ago, I wouldn't have thought that such a great offer, of course especially the 50/50 chance of winning the ticket on days with particle pollution level warnings (…) is possible. Of the seven trips I took in the Verkehrs- und Tarifverbund Stuttgart [the transport and tariff association], four were paid for, two of them were 7 zone tickets.
	Simple booking and payment	App	19	Everything in one app, with only a few clicks to book. This is really practical.
	Offer of vouchers	Special ticket	1	I use car2go and myTaxi via the app, because I will/must use the voucher function.
	Offering a mobility budget	Special ticket	1	The mobility budget is really practical.

service ecosystems like this of the Moovel Group (Albrecht and Ehmke, 2016; Willing et al., 2017a; 2017b) by providing insights into how value co-destruction among actors can be better anticipated, mitigated, and prevented. Our results indicate that, in addition to an increase in value co-creation by improving the quality of the Reach Now app and/or of the provided mobility services (e.g., the provision of clean car-sharing vehicles), improved communication and expectation management can mitigate and prevent value co-destruction, and thus also lead to increased value formation. Many Reach Now app users were angry and frustrated when they had to install an additional app in order to purchase public transport tickets and were not informed about this change sufficiently in advance. Furthermore, users were displeased to discover that they could no longer pay via SEPA direct debit or Paypal and that the reasons for this change were not communicated transparently. In order to avoid such value co-destruction, our study guides practitioners to communicate realistic value propositions to (potential) users and to provide timely information on the reasons for any adjustments.

Finally, our results support automotive companies, such as Daimler AG and the BMW Group, in moving from solely making and selling cars towards providing mobility services, and thus in *successfully adapting their business models* in response to a changing reality. Solutions like the Reach Now app have only recently become available on the market through the ongoing technological progress (e.g., sensors, big data) and the incipient shift in demand, in particular among young adults, away from private car ownership towards the use of alternative mobility services (Circella et al., 2017; Rayle et al., 2014; Umweltbundesamt, 2019) – partly fueled by the problems caused by the predominant usage of private cars. With our study, we show how smart mobility apps like the Reach Now app and the mobility services they distribute (e.g., car2go) can be positioned more attractively on the market by better meeting needs of (potential) users. By supporting the shift of revenue from the sale of cars to mobility services, the long-term existence of the automotive companies can be secured and jobs preserved.

5.3. Limitations and further research

Our work has some limitations that should be addressed by future research. First of all, our data collection and analysis is limited to one case study – the Moovel Group, which offers the Reach Now app. The choice of this case seems appropriate, since the intended shift of automotive companies from the production of cars to providers of mobility services clearly reflects the shift from the G-D logic to the S-D logic, as postulated in the scientific literature (e.g., Gilsing et al., 2018; Vargo and Lusch, 2004). Furthermore, the Reach Now app is the joint offer of Daimler AG and the BMW Group, two of the largest automotive companies worldwide. However, like most smart mobility apps and browser solutions, the Reach Now app focuses on German-speaking Europe (Albrecht and Ehmke, 2016; Willing et al., 2017a; 2017b). Other countries, for example, have a less extensive public transport infrastructure, which may result in different user needs with regard to an app that supports the use of multiple mobility services. To ensure the transferability of the results, further case studies should be conducted in

Table XIV
Value co-creation in phase 5 – Execution.

	Value co-creation	Resource	Number of customers	Exemplary customer review
Phase 5 – Execution	Good navigation	App	2	The app helps me several times a week to find my way around Stuttgart and also in other cities.
	Chic car-sharing vehicles	Car-sharing vehicle	2	Car2go: Chic cars and a large number of cars.
	Clean car-sharing vehicles	Car-sharing vehicle	1	The use of car2go is running smoothly so far. Always nice and clean cars.

Table XV
Value co-creation – Phase independent.

	Value co-creation	Resource	Number of customers	Exemplary customer review
Phase independent	High stability	App	23	Wonderful, just great. I've been using Moovel [now called Reach Now] for a few months now. It is super. Everything works just fine.
	Good functional design	App	20	I like this app. It is chic, has an efficient user workflow and does what it is supposed to do.
	Good customer service	Staff	9	Good. The customer service is first class. I mean this seriously.
	Good visual design	App	8	A very nice design and a high performance.
	Added value	App	7	Ingenious for Stuttgart. Perfect app for the Stuttgart area that combines all possible means of transport. You don't need other apps anymore.
	High performance	App	2	Initially, thumbs up: Short loading times.

future research.

A second limitation also relates to the transferability of the results. In this study, we analyzed the value formation in the business-to-business relationships on the basis of interviews conducted with experts from German public transport organizations. Public transport, which includes bus, subway, tram, and/or regional train services, guarantees the mobility of the German population. The importance of public transport is much higher than, for instance, of car-sharing, as evidenced by more than 10 billion public transport rides in 2017 (Verband Deutscher Verkehrsunternehmen, 2018). However, the other mobility services (e.g., car-, bike- and ride-sharing) to which the Reach Now app provides access are usually offered by private companies who may have different goals and interests than public transport organizations (Schulz and Überle, 2018). For this reason, it is necessary to also examine the value formation in such business-to-business relationships.

Lastly, there are some limitations with regard to the methodology chosen for the analysis of value formation in the customer-to-business relationships. Following the approach taken in other studies (e.g., Dolan et al., 2019; Sthapit and Björk, 2019), we have collected and analyzed customer reviews provided for the Reach Now app. But this approach does not cover users who do not write a customer review, for whatever reason. In addition, due to their format (star rating and customer comment), customer reviews can provide a broad overview on value formation of a large number of users, but only limited deep insights with regard to value formation of individual users.

To address this weakness, future research could use in-depth interviews and customer diaries for data collection. In this way, the value formation could also be examined over a longer period of time, potentially casting light on the factors that influence whether the initiation of a problem-solving process turns initial value co-destruction into value co-creation. Both data collection methods also account for the fact that (potential) users are not a homogeneous group (e.g., economic, cultural, mobility-related, and demographic differences) (Schulz et al., 2020b), since "value is always uniquely and phenomenologically determined by the beneficiary" (Vargo et al., 2008, p. 148).

6. Conclusion

In this study, we examine value formation among different actors embedded in the Moovel Group service ecosystem to improve its establishment and long-term viability. The Moovel Group offers the Reach Now app that makes the use of multiple mobility services during a trip more convenient, and thus contributes to the realization of smart mobility not based on the predominant use of the private car. Currently, however, both the number of users and the number of public transport organizations distributing their mobility services via the Reach Now app is very low. Drawing on the analysis of customer reviews and expert interviews, we develop an interactional phase-based perspective on the value formations in the tripartite relationship between app users, the Moovel Group, and German public transport organizations.

Our results show, in particular, that all four possible links of value co-creation and co-destruction in the underlying dyadic customer-to-business relationships and business-to-business relationships occur in practice. For example, not providing access to the entire range of public transport tickets leads to value co-destruction for app users, while value co-creation takes place for public transport organizations because they can continue to use smartcards for their subscriptions that provide a higher protection against misuse, and because they can remain in direct contact with their customers.

Our research is unique in several ways. This is the first case study of the Moovel Group and their Reach Now app, a joint venture between Daimler AG and the BMW Group that supports their transformation towards mobility service providers. Furthermore, our work complements previous studies that have adopted the S-D logic perspective which mainly (1) focus on non-IT-enabled value formation, (2) neglect the concept of value co-destruction, (3) limit their analysis to single dyadic actor-to-actor relationships, and/or (4) examine an established service ecosystem.

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Declarations of interest

None.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.techfore.2021.120926.

Appendix

Table IV, Table V, Table VI, Table VII, Table VIII, Table IX, Table X, Table XI, Table XII, Table XIII, Table XIV, Table XV

References

Albrecht, L., Ehmke, J.F., 2016. "Innovative Services in der Mobilitätsbranche: Eine Marktanalyse Multimodaler Mobilitätsmanager". Multikonferenz Wirtschaftsinformatik. Ilmenau.

Alexander, M., Jaakkola, E. 2011, "Exploring value co-creation within networks: actor-to-actor service provision within a public transport service system", Industrial Marketing and Purchasing Conference. Glasgow.

Android Google Play Store 2020. Reach Now. URL: https://play.google.com/store/apps/details?id=com.daimler.moovel.android (visited on 2020-01-16).

Bagheri, A., Saraee, M., de Jong, F., 2013. Care more about customers: unsupervised domain-independent aspect detection for sentiment analysis of customer reviews. Knowl. Based Syst. 52, 201–213.

Ballús-Armet, I., Shaheen, S.A., Clonts, K., Weinzimmer, D, 2014. Peer-to-peer carsharing: exploring public perception and market characteristics in the San Francisco Bay Area, California. Transp. Res. Rec. 2416 (1), 27–36.

Benbasat, I., Goldstein, D.K., Mead, M, 1987. The case research strategy in studies of information systems. MIS. Q. 11 (3), 369–386.

Blaschke, M., Riss, U., Haki, K., Aier, S., 2019. Design principles for digital value co-creation networks: a service-dominant logic perspective. Electron. Mark. 29 (3), 443–472.

Bogner, A., Littig, B., Menz, W., 2009. Introduction: expert interviews - an introduction to a new methodological debate. In: Bogner, A., Littig, B., Menz, W. (Eds.), Interviewing experts. Palgrave Macmillan, London, pp. 1–13.

Breidbach, C.F., Maglio, P.P., 2016. Technology-enabled value co-creation: an empirical analysis of actors, resources, and practices. Indust. Market. Manage. 56, 73–85.

Breidbach, C.F. and Ranjan, S. 2017, "How do fintech service platforms facilitate value co-creation? An analysis of twitter data", International Conference on Information Systems. Seoul.

Brendel, A.B., Lichtenberg, S., Prinz, C., Herrenkind, B., 2020. Increasing the value of shared vehicles: insights from an implementation of user-based relocation in station-based one-way carsharing. Sustain. 12 (21).

Brust, L., Breidbach, C.F., Antons, D., and Salge, T.O. 2017, "Service-dominant logic and information systems research: a review and analysis using topic modeling", International Conference on Information Systems. Seoul.

Bundesministerium für Verkehr und digitale Infrastruktur 2017. Carsharing: BMVI gibt Startschuss. URL: https://www.bmvi.de/SharedDocs/DE/Artikel/LA/carsharing-gesetz.html (visited on 2017-10-13).

Büschken, J., Allenby, G.M., 2016. Sentence-based text analysis for customer reviews. Market. Sci. 35 (6), 953–975.

Čaić, M., Odekerken-Schröder, G., Mahr, D, 2018. Service robots: value co-creation and co-destruction in elderly care networks. J. Serv. Manage. 29 (2), 178–205.

Chen, T., Dodds, S., Finsterwalder, J., Witell, L., Cheung, L., Falter, M., Garry, T., Snyder, H., McColl-Kennedy, J.R. 2020, Dynamics of wellbeing co-creation: a psychological ownership perspective, J. Serv. Manage., in press.

Circella, G., Alemi, F., Tiedeman, K., Berliner, R.M., Lee, Y., Fulton, L., Mokhtarian, P.L., Handy, S. 2017, What affects millennials' mobility? Part II: The impact of residential location, individual preferences and lifestyles on young adults' travel behavior in California.

Dey, B.L., Babu, M.M., Rahman, M., Dora, M., Mishra, N., 2019. Technology upgrading through co-creation of value in developing societies: analysis of the mobile telephone industry in Bangladesh. Technol. Forecast. Soc. Chang. 145, 413–425.

Dolan, R., Seo, Y., Kemper, J., 2019. Complaining practices on social media in tourism: a value co-creation and co-destruction perspective. Tour. Manage. 73, 35–45.

Echeverri, P., Skålén, P., 2011. Co-Creation and co-destruction: a practice-theory based study of interactive value formation. Market. Theo. 11 (3), 351–373.

Eisenhardt, K.M., 1989. Building theories from case study research. Acad. Manage. Rev. 14 (4), 532–550.

Firnkorn, J., Müller, M., 2011. What will be the environmental effects of new free-floating car-sharing systems? The case of car2go in Ulm. Ecol. Econ. 70 (8), 1519–1528.

Flick, U., 2009. An introduction to qualitative research. SAGE Publications, London.

Frau, M., Cabiddu, F., Muscas, F., 2018. When multiple actors' online interactions lead to value co-destruction: an explorative case study. In: Lee, I. (Ed.), Diverse methods in customer relationship marketing and management. IGI Global, pp. 163–180.

Gebauer, H., Johnson, M., Enquist, B., 2010. Value co-creation as a determinant of success in public transport services: a study of the Swiss federal railway operator (SBB). Managi. Serv. Qual. 20 (6), 511–530.

Gilsing, R., Turetken, O., Adali, O.E., Grefen, P. 2018, "A reference model for the design of service-dominant business models in the smart mobility domain", International Conference on Information Systems. San Francisco.

Gohary, A., Hamzelu, B., Pourazizi, L., 2016. A little bit more value creation and a lot of less value destruction! Exploring service recovery paradox in value context: a study in travel industry. J. Hospital. Tour. Manage. 29, 189–203.

Gonçalves, P., Araújo, M., Benevenuto, F., Cha, M. 2013, "Comparing and combining sentiment analysis methods", ACM Conference on Online Social Networks. Boston.

Gretzel, U., Sigala, M., Xiang, Z., Koo, C, 2015. Smart tourism: foundations and developments. Electron. Mark. 25 (3), 179–188.

Haki, K., Blaschke, M., Aier, S., Winter, R., 2019. A value co-creation perspective on information systems analysis and design. Bus. Info. Syst. Eng. 61 (4), 487–502.

Hein, A., Scheiber, M., Böhm, M., Weking, J., Rocznik, D., Krcmar, H., 2018. "Toward a design framework for service-platform ecosystems". European Conference on Information Systems. Portsmouth.

Hildebrandt, B., Hanelt, A., Firk, S., 2018. Sharing yet caring: mitigating moral hazard in access-based consumption through IS-enabled value co-capturing with consumers. Bus. Info. Syst. Eng. 60 (3), 227–241.

Hildebrandt, B., Hanelt, A., Piccinini, E., Kolbe, L.M., Nierobisch, T., 2015. The value of IS in business model innovation for sustainable mobility services - the case of carsharing. International Conference on Wirtschaftsinformatik, Osnabrück.

Hodapp, D., Hawlitschek, F., Kramer, D. 2019, "Value co-creation in nascent platform ecosystems: a delphi study in the context of the internet of things", International Conference on Information Systems. Munich.

Kim, H., Tan, F., Leong, C., Kim, D.D., Ondrus, J., Tan, B. 2018, "Value co-creation in digital content ecosystems: a study of "hallyu"", International Conference on Information Systems. San Francisco.

Kokko, J., Vartiainen, T., Tuunanen, T. 2018, "Value co-creation and co-destruction in online video games: an exploratory study and implications for future research", Hawaii International Conference on System Sciences. Hawaii.

Koskela-Huotari, K., Edvardsson, B., Jonas, J.M., Sörhammar, D., Witell, L., 2016. Innovation in service ecosystems—breaking, making, and maintaining institutionalized rules of resource integration. J. Bus. Res. 69 (8), 2964–2971.

Laksono, R.A., Sungkono, K.R., Sarno, R., Wahyuni, C.S., 2019. Sentiment analysis of restaurant customer reviews on TripAdvisor using naïve bayes. International Conference on Information & Communication Technology and System. Surabaya.

Laud, G., Bove, L., Ranaweera, C., Leo, W.W.C., Sweeney, J., Smith, S, 2019. Value co-destruction: a typology of resource misintegration manifestations. J. Serv. Market. 33 (7), 866–889.

Leroi-Werelds, S., 2019. An update on customer value: state of the art, revised typology, and research agenda. J. Serv. Manage. 30 (5), 650–680.

Lintula, J., Tuunanen, T., Salo, M., Myers, M.D., 2018. When value co-creation turns to co-destruction: users' experiences of augmented reality mobile games. International Conference on Information Systems. San Francisco.

Lusch, R.F., Nambisan, S., 2015. Service innovation: a service-dominant logic perspective. MIS. Q. 39 (1), 155–175.

Maglio, P.P., Vargo, S.L., Caswell, N., Spohrer, J., 2009. The service system is the basis abstraction of service science. Info. Syst. e-Business Manage. 7 (4), 395–406.

Malthouse, E.C., Buoye, A., Line, N., El-Manstrly, D., Dogru, T., Kandampully, J., 2019. Beyond reciprocal: the role of platforms in diffusing data value across multiple stakeholders. J. Serv. Manage. 30 (4), 507–518.

Marx, R., de Mello, A.M., Zilbovicius, M., de Lara, F.F., 2015. Spatial contexts and firm strategies: applying the multilevel perspective to sustainable urban mobility transitions in Brazil. J. Clean. Prod. 108, 1092–1104.

Mauksch, S., von der Gracht, H.A., Gordon, T.J, 2020. Who is an expert for foresight? A review of identification methods. Technol. Forecast. Soc. Chang. 154.

Meng, Z., Li, E.Y., Qiu, R., 2020. Environmental sustainability with free-floating carsharing services: an on-demand refueling recommendation system for car2go in Seattle. Technol. Forecast. Soc. Chang. 152.

Mikalef, P., Pappas, I.O., Giannakos, M.N., 2017. Value co-creation and purchase intention in social commerce: the enabling role of word-of-mouth and trust. Americas Conference on Information Systems. Boston.

Miles, M.B., Huberman, A.M., Saldaña, J., 2014. Qualitative data analysis: a methods sourcebook. SAGE Publications, Los Angeles.

Moovel 2019. Darum wird aus der Moovel App Reach Now. URL:https://www.moovel.com/de/news-ressourcen/blog/darum-wird-aus-der-moovel-app-reach-now (visited on 2020-01-06).

Moovel 2020. Partner des Öffentlichen Verkehrs. URL: https://www.moovel.com/de/partner/public-transport-partners (visited on 2020-01-16).

Mudambi, S.M., Schuff, D, 2010. What makes a helpful online review? A study of customer reviews on Amazon.com. MIS. Q. 34 (1), 185–200.

Myers, M.D., Newman, M., 2007. The qualitative interview in Is research: examining the craft. Info. Organiz. 17 (1), 2–26.

Nadeem, W., Juntunen, M., Shirazi, F., Hajli, N., 2020. Consumers' value co-creation in sharing economy: the role of social support, consumers' ethical perceptions and relationship quality. Technol. Forecast. Soc. Chang. 151.

Nambisan, S., Nambisan, P., 2008. How to profit from a better 'virtual customer environment'. MIT. Sloa. Manage. Rev. 49 (3), 53–61.

Nischak, F., Hanelt, A., Kolbe, L.M., 2017. "Unraveling the interaction of information systems and ecosystems - a comprehensive classification of literature". International Conference on Information Systems. Seoul.

Nunes, A.A., Galvão, T., e Cunha, J.F., 2014. Urban public transport service co-creation: leveraging passenger's knowledge to enhance travel experience. Procedia - Social Behav. Sci. 111 (5), 577–585.

Oelke, D., Hao, M., Rohrdantz, C., Keim, D.A., Dayal, U., Haug, L.-.E., Janetzko, H. 2009, "Visual opinion analysis of customer feedback data", IEEE Symposium on Visual Analytics Science and Technology. Atlantic City.

Oelke, D., Hao, M., Rohrdantz, C., Keim, D.A., Dayal, U., Haug, L.-E., Janetzko, H., 2009. Visual opinion analysis of customer feedback data. IEEE Symposium on Visual Analytics Science and Technology. Atlantic City.

Payne, A.F., Storbacka, K., Frow, P., 2008. Managing the co-creation of value. J. Acad. Market. Sci. 36 (1), 83–96.

Plé, L., 2016. Studying customers' resource integration by service employees in interactional value co-creation. J. Serv. Market. 30 (2), 152–164.

Plé, L., 2017. Why do we need research on value co-destruction? J. Creat. Valu. 3 (2), 162–169.

Plé, L., Cáceres, R.C., 2010. Not always co-creation: introducing interactional co-destruction of value in service-dominant logic. J. Serv. Market. 24 (6), 430–437.

Prior, D.D., Marcos-Cuevas, J., 2016. Value co-destruction in interfirm relationships: the impact of actor engagement styles. Market. Theo. 16 (4), 533–552.

Rahman, M., Bose, S., Babu, M.M., Dey, B.L., Roy, S.K., Binsardi, B., 2019. Value co-creation as a dialectical process: study in Bangladesh and Indian Province of West Bengal. Info. Syst. Fronti. 21 (3), 527–545.

Rayle, L., Shaheen, S., Chan, N., Dai, D., Cervero, R., 2014. App-based, on-demand ride services: comparing taxi and ridesourcing trips and user characteristics in San Francisco.

Reinhardt, W., 2012. Öffentlicher Personennahverkehr: Technik - rechtliche und betriebswirtschaftliche Grundlagen. Vieweg+Teubner Verlag, Wiesbaden.

Schreieck, M., Pflügler, C., Setzke, D.S., Wiesche, M., Krcmar, H., 2018. Improving urban transportation: an open platform for digital mobility services. In: Linnhoff-Popien, C., Schneider, R., Zaddach, M. (Eds.), Digital marketplaces unleashed. Springer, Berlin, pp. 479–489.

Schulz, T., Böhm, M., Gewald, H., Celik, Z., Krcmar, H., 2020a. The negative effects of institutional logic multiplicity on service platforms in intermodal mobility ecosystems. Bus. Info. Syst. Eng. 62 (5), 417–433.

Schulz, T., Böhm, M., Gewald, H., Krcmar, H. 2019, "Door-to-door mobility integrators as keystone organizations of smart ecosystems: resources and value co-creation – a literature review", International Conference on Wirtschaftsinformatik. Siegen.

Schulz, T., Böhm, M., Gewald, H., Krcmar, H. 2020b, "Smart mobility – an analysis of potential customers' preference structures", electronic markets, in press.

Schulz, T., Gewald, H., Böhm, M., 2018. "The long and winding road to smart integration of door-to-door mobility services: an analysis of the hindering influence of intra-role conflicts". European Conference on Information Systems. Portsmouth.

Schulz, T., Gewald, H., Böhm, M., Krcmar, H. 2020c, "Smart mobility: contradictions in value co-creation", Info. Syst. Fronti., in press.

Schulz, T., Ikonomou, G. 2020, "How countervailing power affects value co-creation among service providers: a comparison of the travel and mobility sectors", Pacific Asia Conference on Information Systems. Dubai.

Schulz, T., Überle, M., 2018. How institutional arrangements impede realization of smart ecosystems: the case of door-to-door mobility integrators. European Conference on Information Systems. Portsmouth.

Schumpeter, J.A., 2012. The theory of economic development: an inquiry into profits, capital, credit, interest, and the business cycle. Transaction Publishers, New Brunswick.

Schüritz, R., Farrell, K., Wixom, B., Satzger, G. 2019, "Value co-creation in data-driven services: towards a deeper understanding of the joint sphere", International Conference on Information Systems. Munich.

Sedoglavich, V., Dabić, M, 2017. Does being a member of the cluster matter in the process of value creation through internationalization? In: Marinova, S., Larimo, J., Nummela, N. (Eds.), Value creation in international business. Palgrave Macmillan, Cham, pp. 245–270.

Sigala, M., 2018. Value co-destruction in service ecosystems: findings from TripAdvisor. In: Sigala, M., Gretzel, U. (Eds.), Advances in social media for travel, tourism and hospitality: new perspectives, practice and cases. Routledge, New York.

Smith, A.M., 2013. The value co-destruction process: a customer resource perspective. Eur. J. Mark. 47 (11/12), 1889–1909.

Spohrer, J., Vargo, S.L., Caswell, N., Maglio, P.P. 2008, "The service system is the basic abstraction of service science", International Conference on System Sciences. Hawaii.

Spohrer, J.C., Maglio, P.P., 2010. Toward a science of service systems: value and symbols. In: Maglio, P.P., Kieliszewski, C.A., Spohrer, J.C. (Eds.), Handbook of service science. Springer, Boston, pp. 157–194.

Stake, R.E., 1994. Case studies. In: Denzin, N.K., Lincoln, Y.S. (Eds.), Handbook of qualitative research. SAGE Publications, Thousand Oaks, pp. 236–247.
Sthapit, E., Björk, P., 2019. Sources of value co-destruction: Uber customer perspectives. Tour. Rev. 74 (4), 780–794.
Stiller, C., León, F.P., Kruse, M., 2011. Information fusion for automotive applications – an overview. Info. Fus. 12 (4), 244–252.
Storbacka, K., Brodie, R.J., Böhmann, T., Maglio, P.P., Nenonen, S., 2016. Actor engagement as a microfoundation for value co-creation. J. Bus. Res. 69 (8), 3008–3017.
Strauss, A.L., Corbin, J.M., 1998. Basics of qualitative research: techniques and procedures for developing grounded theory. SAGE Publications, Thousand Oaks.
Teubner, T., Flath, C.M., 2015. The economics of multi-hop ride sharing. Creating new mobility networks through IS. Bus. Info. Syst. Eng. 57 (5), 311–324.
Titov, I., McDonald, R. 2008, "Modeling online reviews with multi-grain topic models", International Conference on World Wide Web. Beijing.
Turetken, O., Grefen, P., Gilsing, R., Adali, O.E., 2019. Service-dominant business model design for digital innovation in smart mobility. Bus. Info. Syst. Eng. 61 (1), 9–29.
Umweltbundesamt 2019, "Veränderungen im Mobilitätsverhalten zur Förderung einer nachhaltigen Mobilität".
van Riel, A.C.R., Zhang, J.J., McGinnis, L.P., Nejad, M.G., Bujisic, M., Phillips, P.A., 2019. A framework for sustainable service system configuration: exploring value paradoxes with examples from the hospitality industry. J. Serv. Manage. 30 (3), 349–368.
Vargo, S.L., Lusch, R.F., 2004. Evolving to a new dominant logic for marketing. J. Mark. 68 (1), 1–17.
Vargo, S.L., Lusch, R.F., 2016. Institutions and axioms: an extension and update of service-dominant logic. J. Acad. Market. Sci. 44 (1), 5–23.
Vargo, S.L., Lusch, R.F., 2017. Service-dominant logic 2025. Int. J. Res. Market. 34 (1), 46–67.
Vargo, S.L., Maglio, P.P., Akaka, M.A., 2008. On value and value co-creation: a service systems and service logic perspective. Eur. Manage. J. 26 (3), 145–152.
Venkatesh, V., Brown, S.A., Bala, H., 2013. Bridging the qualitative-quantitative divide: guidelines for conducting mixed methods research in information systems. MIS. Q. 37 (1), 21–54.
Verband Deutscher Verkehrsunternehmen, 2018. 2017 Statistik.
Weeger, A., Ott-Schwenk, A. 2017, "What teams need to be clear about - an activity theoretical perspective on shared understanding in health Is implementation", International Conference on Wirtschaftsinformatik. St. Gallen.
Wells, P., Wang, X., Wang, L., Liu, H., Orsato, R., 2020. More friends than foes? The impact of automobility-as-a-service on the incumbent automotive industry. Technol. Forecast. Soc. Chang. 154.
Willing, C., Brandt, T., Neumann, D, 2017a. Electronic mobility market platforms – a review of the current state and applications of business analytics. Electron. Markets 27 (3), 267–282.
Willing, C., Brandt, T., Neumann, D, 2017b. Intermodal mobility. Bus. Info. Syst. Eng. 59 (3), 173–179.
Ye, J., Zheng, J., Yi, F, 2020. A study on users' willingness to accept mobility as a service based on UTAUT model. Technol. Forecast. Soc. Chang. 157.
Yin, J., Qian, L., Shen, J., 2019. From value co-creation to value co-destruction? The case of dockless bike sharing in China. Transp. Res. Part D: Transp. Environ. 71, 169–185.
Yin, R.K., 2018. Case study research and applications: design and methods. SAGE Publications, Los Angeles.
Zimmermann, S., Schulz, T., Ikonomou, G., Gewald, H. 2020, "Impediments of intermodal mobility: a service-dominant logic perspective", Pacific Asia Conference on Information Systems. Dubai.

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Appendix L. An Overview of Further Publications, not Embedded in the Thesis

Authors	Title	Outlet – Publication date	VHB-Ranking[1]
Schulz, Rockmann, Weeger	Service Composition in Networks – Towards a Typology of Intermediaries	Americas Conference on Information Systems (AMCIS) – 2016	D
Zimmermann, Schulz, Gewald	Salient Attributes of Mobility Apps: What Does Really Matter for the Citizen?	Pacific Asia Conference on Information Systems (PACIS) – 2020	C
Zimmermann, Schulz, Ikonomou, Gewald	Impediments of Intermodal Mobility: A Service-Dominant Logic Perspective	Pacific Asia Conference on Information Systems (PACIS) – 2020	C
Zimmermann, Hein, Schulz, Gewald, Krcmar	Digital Nudging Toward Pro-Environmental Behavior: A Literature Review	Pacific Asia Conference on Information Systems (PACIS) – 2021	C
[1] VHB: German Academic Association for Business Research			

Table 20. Overview on Further Publications, not Embedded in the Thesis.