

# Creating and developing the actor-network for a car manufacturing firm's mobility services

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## **Abstract**

Changes in urban travel behaviour, customer perception of car ownership and government policies support the rise of mobility services. Car manufacturing firms join in this new service ecosystem, which is complex in nature and requires collaboration between several actors. Scholars have explored these mobility services, but the literature does not yet provide sufficient knowledge on the emergence and evolution of these mobility service networks. This study aims to shed light on how a car manufacturing firm creates and expands its mobility service network, and who and what the key actors and their activities in the network are. The document analysis method was used in this study. The actor-network theory framework was used to interpret the empirical observations. The results reveal the process of mobility service network evolution and the actors who join the network by offering their core business services. It concludes by presenting a new actor category, co-branding actors.

## 1 Introduction

Urban transportation has experienced major changes in recent times. Customized mobility solutions are becoming increasingly popular for urban transportation needs, improving urban mobility and reducing private car utilization. These mobility services are attracting much attention from researchers, policy makers and the automotive industry. Academic scholars have explored mobility services from different perspectives such as cost-based analysis (Bösch *et al.*, 2017), business models (Lisson *et al.*, 2015), impact on the automotive industry (Spulber and Dennis, 2016), travel behaviour and preferences (Miramontes *et al.*, 2017), and competences (Proff *et al.*, 2015). But the empirical research is still insufficient to provide knowledge on how car manufacturers initiate and expand their mobility services, who their partners are and what their partners' activities in the network are. Hence, this study sheds light on mobility services from the car manufacturer's perspective, analysing their evolution and partners' activities in the network.

Mobility service (or Mobility as a service, MaaS) is a relatively new concept in service literature and a basic definition has not yet been established. European Mobility as a Service Alliance has defined MaaS in broad terms as follows:

“Put the users, both travellers and goods, at the core of transport services, offering them tailored mobility solutions based on their individual needs. This means that, for the first time, easy access to the most appropriate transport mode or service will be included in a bundle of flexible travel service options for end users” (Eupomm, 2017).

In line with this description, we view mobility services as any tailored solution that firms or individuals offer users (other firms or consumers) to fulfill their individual and varying travel and transportation needs.

The changing paradigm of urban mobility has increased the need for innovative solutions to fulfill the individualized travel demand. One possible solution to these issues is

shifting towards shared mobility services (on-demand cars, car sharing, carpooling, etc.), especially in combination with traditional public transport so that various transport modes can join together to serve as substitutes to owning private vehicles (Kamargianni *et al.*, 2016). The integration of new technologies and the development of more user-focused concepts of mobility are favouring the entry of newcomers, such as car manufacturers, powerful high-tech corporations, data management companies and energy companies, who are exploiting new business models, new approaches and innovative ideas from software solutions to new vehicle concepts (Cassetta *et al.*, 2017).

Market change and the promising revenue stream are prompting car manufacturing firms to initiate mobility services. For example, Schmidt *et al.* (2018) suggest that by the year 2030, revenues from manufacturing and selling vehicles will be around €2 trillion, while revenues from mobility services are projected to soar to almost €1.2 trillion. Many car manufacturing firms offering mobility services, such as BMW's ReachNow, Daimler's Car2go and Volkswagen's MOI, are directly involved to some extent in these services. Daimler Auto Group entered the market with Car2Go, a car-sharing organization, with a fleet composed entirely of Smart fortwo. It began with a pilot program in Austin, Texas, providing several car sharing innovations. BMW DriveNow began in Munich in June 2011 and is now operating throughout Germany and in several other countries. These mobility services have been further expanded, and new actors have joined the networks. Some of these service systems are operated by local organizations, such as Arriva in Copenhagen and OP financials in Helsinki (Kortum *et al.*, 2016). The market expansion rate and customer interest in mobility services have caused many automotive firms and other start-up companies to focus on this service business. For example, Volkswagen entered the mobility services business by collaborating with an on-demand mobility provider Gett in 2011, and Volvo Car Corporation started collaborating with

Siemens, launching E-mobility services in 2011. A start-up firm MaaS Global started integrated mobility services in 2016 and is growing at a remarkable rate (Warwick *et al.*, 2017).

The previous description of car manufacturers' activities shows that the manufacturers required various partners when entering the mobility service market and pursuing new business with services. As service businesses operate on a different logic than goods businesses, manufacturing firms need to reconsider their supply and delivery chains, and their connection points to customers. Previous research has not covered this network perspective on car manufacturers' mobility services sufficiently. Therefore, we focus on the mobility services offered by a car manufacturer in Europe, pursuing increased knowledge on the firm's creation of the actor-network for mobility services. This study has two research questions:

*RQ1. How does a car manufacturer build its mobility service network?*

*RQ2. How are the different actors positioned in the car manufacturer's mobility service network?*

The goal of this study is to understand the early-phase evolution of the actor-network involved in the car manufacturer's mobility services. This study is purposefully focused on an early adopter company and explores the early experiences in establishing the actor-network. Investigating such an early adopter will provide thorough knowledge on designing, implementing and extending these services and on the emergence of the actor-network for mobility services.

This paper is organized as follows: after the Introduction (Section 1), the second section explores the literature on mobility services and proposes the Actor-Network Theory (ANT) as the foundation for exploring the emergence of the network for mobility services. The third section introduces the research design, the case firm background, the nature of the data and the source. In the fourth section, the findings present the comprehensive view of mobility service development from the ANT framework and the different actors' activities. The fifth section discusses the findings, comparing them to earlier mobility service research. The paper

concludes (Section 6) by discussing how the mobility service network evolved and developed over time, focusing particularly on collaborations with other actors, and on who the other actors involved in the mobility services were. The paper ends by suggesting some theoretical implications of the actor-network theory in service design and some practical implications for collaborative agreements, presenting the limitations of this study and future avenues for research.

## **2 Literature review**

### **2.1 Mobility services**

Mobility services are a new transportation solution (Jittrapirom *et al.*, 2017), and several schemes such as car-sharing, carpooling and cars on-demand have emerged around the world (Kamargianni *et al.*, 2016). These mobility services have been defined in different ways by various scholars. For example, the first definition was offered by Hietanen (2014) as;

“Mobility distribution model that delivers users’ transport needs through a single interface of a service provider. It combines different transport modes to offer a tailored mobility package, like a monthly mobile phone contract.”

Burrows *et al.* (2015) extended this definition further as:

“A new way to provide transport, which facilitates users to get from A to B by combining available mobility options and presenting them in a completely integrated manner.”

MaaS can be considered as the novel mobility concept that promotes customizing various mobility solutions for customer needs. It not only meets the needs of urban mobility, but it also promotes a sustainable mode of transportation. Table 1 summaries the literature on mobility services and their research focus. Apart from customer demand, this mobility concept offers some environmental benefits such as an opportunity to decarbonize the transport sector (Gould *et al.*, 2015) and implement the sustainability vision (Holmberg *et al.*, 2016).

Growing trends in urban mobility, sharing transportation, environmental policies, customer behavior, and the economic conditions have forced the automotive industry to focus on these integrated transportation services. Various mobility service schemes such as carpooling and car sharing are becoming increasingly popular in Europe and America due to their flexibility, pricing system and choice of various models (Perboli *et al.*, 2017). Car manufacturers (Daimler, BMW, and Volkswagen) are directly involved in car-sharing operations, seeking new channels to market their cars, extend their business portfolio and increase revenue. BMW currently has over 900,000 members and 11,000 vehicles and Car2Go has 2,900,000 members and 14,000 cars in several countries (Hawkins, 2018). Car-sharing requires the active involvement of companies, customers, public authorities and municipalities, and it also requires strong cooperation among different actors in the system. Several actors need to collaborate for a scalable integrated mobility service to materialize (Holmberg *et al.*, 2015). Especially in bigger countries, coordination is a huge challenge. If long distances and urban services are to be combined, this requires separate negotiations with a large number of operators (Finger *et al.*, 2015).

Even if car manufacturers take a lead in developing and offering mobility services, they need to identify and engage stakeholders in the network in a broader sense. Hanley (2013) suggests a categorization of mobility stakeholders, splitting them into infrastructure providers, city administrators and transport modes operators. The Urban ITS Expert Group (2013) grouped these stakeholders into public and private actors, expanding the categorization by including the users of mobility services and stating that users in particular can contribute to refining services by providing feedback. Later, Van Audenhove *et al.* (2014) named the three main stakeholders – the city administration, the private sector and the citizens – who lay out the purpose and objectives of the mobility system. Janasz (2018) grouped the main actors of the mobility arena into 3 categories: public, private and customers. These three groups

represent different actors who manage different activates of the value chain of mobility services. These actors need to define their own value proposition and then form partnerships to build and deliver products and services (Somnath *et al.*, 2017). Shah (2018) suggested that customers involvement in new service innovation should treated as a successful strategy to improve services of the firms.

Meanwhile, incumbent transport operators are beginning to understand that their business models will likely need to change, and along with that their role in the emergent ecosystem as they seek to harness technological advances that enable a wider range of choices, different uses of data and a higher level of responsiveness (Warwick *et al.*, 2017). The number of private-sector providers seeking to meet the local transportation services needs (Warwick *et al.*, 2017). The key factor for MaaS a success is working together will all actors in the ecosystem. Private sector participants might join the movement in search of profits, while government agencies could be motivated by the public policy benefits that stem from reduced congestion: higher productivity, better air quality, fewer traffic accidents and a smaller urban footprint for parking (Warwick *et al.*, 2017). While the first type of competitors attacks incumbent car manufacturers on their home turf by providing new types of cars for people to buy, the second type threatens the foundations of the car manufacturing industry by providing customers with a substitute to owning a car in the first place. In response to this threat, premium car manufacturers such as Daimler, BMW and AUDI are going beyond using digital technologies to create smart, connected cars; these firms starting to develop IT-enabled mobility services, built around car sharing (Mocker and Fonstad, 2017).

Mobility services require the integration of different partners since no single company can satisfy the needs of all customers, given the complexity of urban mobility systems (Spickermann *et al.*, 2014). New actors, networks and technologies are fundamentally challenging the extant regime of transportation (Docherty *et al.*, 2017). Sarasini (2016)



proposes that collaborative approaches to integration must focus on two dimensions. The first dimension includes individual mobility service providers who constitute the business model ecosystem to make MaaS business models operable and economically viable. A second dimension includes a broader range of stakeholders with divergent interests and visions, who are critical to the legitimacy of MaaS offerings. The integration of diverse stakeholder interests through participatory processes is essential for securing commitments to sustainable mobility and for overcoming private car ownership (Banister, 2008).

Even though this mobility service business is more attractive for firms, it still needs to address some issues. For example, Lyons (2016) stated that urban mobility is dynamic in nature, and faces significant change and uncertainty. Mobility service providers need to understand this complexity and consider how to interact among a wider set of actors and processes which define and co-create the evolution of the urban mobility system. They also need to look at the interests of public sector clients (*regulators*) and end users.

To sum up, some scholars (see table 1) have discussed the importance of collaboration with different actors, such as public and private partners, for the success of mobility services. However, previous research has not provided sufficient indications on how the network with other actors emerges and evolves. There is a need to understand how car manufacturers can activate the network with other actors, and how these actors engage in mobility service expansion. To address these issues, we expanded the literature review to the actor-network theory, which can be used as an analytical tool to explain the evolution of technology innovation and partner networks.

### **Insert Table 1**

## 2.2 Actor-network theory for mapping the emerging network for mobility services

Actor-network theory (ANT) is a theoretical approach to social theory where everything in the social and natural worlds exist in constantly shifting networks of relationships

(Simandan, 2017). ANT was first developed by Michel Callon, Bruno Latour and John Law in the early 1980s. According to Law and Callon (1988), a network seeks to: define and distribute roles, and mobilize or invent others to play these roles. Such roles may be social, political, technical or bureaucratic in character; the objects that are mobilized to fill them are also heterogeneous and may take the form of people, organizations, machines or scientific findings. ANT is a useful framework that allows researchers to trace how networks come into being, how human and technological actors are involved in the networks, the interactions between different actors, and how the networks achieve stability or otherwise. ANT originated in science and technology studies as an approach to social theory and research. The primary objective of ANT is to explore how networks are built or assembled, and maintained, to achieve a specific objective (Vicsek *et al.*, 2016).

Scholars from various domains have shown interest in applying ANT in research. For example, in their technological innovation study, Bledin and Shewmake (2004) stated that ANT can be helpful in highlighting the role of technology users or end customers. Uden and Francis (2009) believe that ANT can be used as a theoretical lens to study the development and adoption of service innovations. It is well suited to explain and help with the design of service systems. The development and adoption of service innovations require the integration of multiple elements including people, technologies and networks across organizations. Technologies and actors' interests need to be aligned and coordinated for successful service innovation. They showed how ANT is adopted as a theoretical framework for understanding the relationships among the actors and for showing how these actors' needs are shaped by the network formation during the development and adoption of service innovation by a university. Adaba and Ayoung (2017) stated that the ANT perspective can be helpful in demonstrating how non-human actors are not only passive but also active participants, who interact with human actors to facilitate the development of an actor-network. Their study also confirms

ANT as a theoretical framework for examining the deployment and diffusion of innovations information and communication technologies for development research.

Adamides and Karfaki (2016) study develop a conceptual framework by using actor-network theory to explain organisation's strategic processes. With this framework the authors analyse an operations-led strategic initiative in a training services provider, by focusing on its linking to the operations and business level strategic processes.

Carroll *et al.* (2012) presented a literature review on Actor-Network Theory (ANT), discussing how it can be employed to examine the socio-technical nature of service networks. They stated that ANT offers a rich vocabulary to describe the interplay of the socio-technical dynamics that influence the service system reconfiguration. This study also discusses why ANT is considered as suitable for application in service science research. It focuses on the concepts of '*materiality*,' '*inscription*,' and '*translation*', explaining how the introduction of a service system impacts the structure of a service network. The study offers a discussion on how ANT may be employed to examine the complexity of service systems and service innovation.

The evaluation of a network is influenced by many factors such as focal actor interest, representative and commercial actors, and even customer demand. Kimbrell (2016) studied the impact of specific actors and technologies on the process of sustainable energy transitions in road transport. ANT was applied in a local level case study of an electric car-sharing company in Brno, Czech Republic. Kimbrell (2016) study revealed that both the human and material actors within this network play crucial roles which influence its successful expansion. These roles are negotiated by the different actors, in response to the negotiated issues particularly surrounding the material elements of the network (Kimbrell, 2016).

Mutual cooperation between different actors influences the expansion and success of mobility services. In his thesis, Noll (2017) explored the urban niche dynamics of car sharing in two locations: Malmö, Sweden, and San Francisco, California. Both Malmö and San

Francisco have specific, politically adopted agendas to ease their respective mobility environments away from private vehicle dependency. He concluded that to accomplish this goal, the cities need to ensure that there is mutually beneficial collaboration between alternative mobility providers. Examples such as the prohibition of bikes on BART (Bay Area Rapid Transit) during commuting hours demonstrate the need for coordination within the actor-network if the city wishes to reach its goals. To sum up, service networks become increasingly complex when technology is implemented to execute specific service processes. More specifically, mobility service takes place in a complex environment that may be difficult to examine and manage. It was found that few efforts have been made to apply the theoretical lens of ANT to understanding the role of each actor within a mobility service network. Hence, scholars need to focus on this mobility service domain to understand its complexity and promote the creation of successful networks for it. We believe that ANT could be a suitable analytical tool to explore the emerging mobility services network. More specifically, it could be useful in revealing how partner networks are built and identifying the activities carried out by each actor in the network.

### **3 Methodology**

#### **3.1 Research design and case selection**

This study used a qualitative research strategy, which is an appropriate approach for comprehensively studying the service journey (Edmondson and Mcmanus, 2007). To achieve the objectives, the study adopted an exploratory single case study approach (Stake, 1995). Given the theoretical immaturity of the research phenomenon of mobility services, a single case study is appropriate as this allows for a thorough research inquiry from as close to the research phenomenon as possible (Dyer and Singh, 1998). A single case, based on detailed qualitative data, can provide good illustrations of the dynamic processes played out over time

(Siggelkow, 2007), and can generate insights about a particular issue or topic (Stake, 2000), such as the mobility services in the automotive industry.

A document-based method (Bowen, 2009) was applied to extract the data. Document analysis is a systematic procedure for reviewing and evaluating both printed documents and electronic material. It is particularly applicable to qualitative case studies, intensive studies that produce rich descriptions of a single phenomenon, event, organization or program (Stake, 2000; Yin, 1994). When selecting the case, the main focus was on large car manufacturing firms in Europe. We primarily sought a front-runner firm that would be exemplary in terms of adopting mobility services. We also looked at different firms' market growth, number of partners and number of added value services alongside the mobility services. After reviewing extant alternatives, we focused on one car manufacturer in Europe, BMW Group. This company started mobility services in 2011, and currently offers services in Germany, Austria, UK, Finland, Sweden, Italy, Denmark, Portugal and Belgium

### 3.2 Case company

The BMW Group is the world's premium manufacturer of automobiles and motorcycles and also provides financial and mobility services. As a global company, the BMW Group operates 31 production and assembly facilities in 14 countries and has a global sales network in more than 140 countries. In 2017, the BMW Group sold over 2,463,500 passenger vehicles and more than 164,000 motorcycles worldwide. The profit before tax in the 2017 financial year was € 10.655 billion on revenues amounting to € 98.678 billion. As of 31 December 2017, the BMW Group had a workforce of 129,932 employees. The group has been offering value-added services like infotainment, parking solutions, and more advanced services like mobility services along with core business services ranging from spares, repairs and fleet maintenance to more complex (customized) services, since 2011 (BMW Pressnote, 2018).

### 3.3 Data collection

The study focused on BMW mobility service (Drive Now) developments during the period 2007-2018 (January). The group actively started offering mobility services in Germany in the year 2011. The mobility service network is our unit of analysis. The primary data was gathered from BMW press releases, websites and annual reports (2007-2017), and the secondary data from company announcements, collaboration announcement news items from automobile magazines, and websites. The authenticity of the data collected from websites was established through cross-checking with the company's official press releases and annual reports (*See Table 2*).

#### **Insert Table 2**

The authors believe that these official data sources are suitable for tracking the firm's strategic movements and actions, as the documents are generated by the firm itself to provide information about their advancement, activities and engagements. The literature also approves the use of publicly available data as research data. Some examples are:

"One of the advantages of the public document as data is that the researcher can identify themes that are not visible 'to the naked eye'. Publicly available data often convey important and useful information that a researcher can effectively use as data" (Bruce 2011, p.214).

"Private records such as unsolicited documents are particularly useful for creating case studies of life history. Typically, owing to the personal nature of private documents, the subjects' own definitions of the situation emerge in private records, along with the way they make sense of their daily living routines. More precisely, these bites of self-disclosure allow researchers to draw out a complete picture of the subjects' perceptions of the life experiences" (Bruce 2011, p.220-).

### 3.4 Data analysis

In this study, we use a coding technique to identify concepts and to categorize themes from the data by applying the first two steps of Strauss and Corbin's (2014) category. The ATLAS.ti 8 coding application was used to code the data. All the documents were uploaded into the application and the open coding tool was used to detect and label concepts and quotes in the text. The data were then categorized into the following actor-network evolution steps (Callon, 1986):

*Problematization*: Defining the nature of the problem and the consequential establishment of dependency.

*Interessement*: Defining other actor roles in resolving that problem.

*Enrolment*: Defining and interrelating the roles that were allocated to other actors in the previous step.

*Mobilization*: Ensuring that supposed spokespersons for relevant collective entities are properly representative of all members of the network.

Table 3 demonstrates how the activities involved in the phases of the emergence of the network were mapped in the data, using sample quotes taken from the data. The focal actor refers to the BMW Group.

#### **Insert Table 3**

The data were further analyzed to classify the actors, focusing particularly on their specific position in the mobility services network. The main focus of the analysis was on the activities performed by the various actors in the mobility service network. In this study, BMW is as the *focal actor* who initiated and monitors the mobility service network. The actors were classified into 3 groups (adapted from Sadeghian *et al.*, 2012).

1. Demand-side actors: Mobility services users or customers

2.Regulatory actors: Local authorities who provide infrastructure facilities such as parking spaces, charging station spaces and legal permits.

3.Supply-side actors: Service firms who provide services related to vehicle infrastructure and transportation.

Additionally, the coding revealed a fourth category of actors that did not fit directly into any of the three initial categories, and this novel category was labeled “Co-branding actors”. These actors promoted mobility services in their own business and typically offered some complementary services, which were not necessarily directly dealing with vehicles or transport.

#### **4 Findings**

The manufacturing industry was hit by recession across the globe in 2008. Sales volume in the automotive industry dropped dramatically and the focal actor announced a 14 % decrease worldwide (BMW annual report 2008, p.18). All these market conditions prompted the case firm to develop a new strategy for added value services, setting up a separate organizational unit known as ‘*Project I*’ as part of the Number ONE strategy to develop new mobility concepts. The firm revealed their expansion plans in the 2010 annual report:

‘For many years we have successfully been providing car-related services for BMW and MINI customers under the name BMW ConnectedDrive. This range of services will be significantly expanded in the future. The strategy is in line with our full-coverage approach, which includes vehicle-related and non-vehicle-related mobility services designed to cover the whole spectrum of premium mobility services.’(BMW Annual report 2010, p.40)

This section is an analysis of the evolution of the mobility service in BMW’s network, explaining the role of the different actors in the network.

##### **4.1 Mobility service network evolution**

The results show that the mobility service network began in 2011 and there had been thirty collaborating actors up to 2018 (January). The evolution of the mobility service network was mapped through the four stages of ANT (Law and Callon, 1988).



#### 4.1.1 Problematization

The rise of alternative urban travel solutions has changed patterns of car ownership, and a drop in vehicle sale has forced the focal actor to change their business model. To understand customer behavior around mobility services, the firm set up a separate organizational unit known as “Project I [to] develop new mobility concepts, especially for densely populated areas”. The project enabled the firm to assess customer behavior around urban mobility and market demand for new mobility services. Ian Robertson explained the market conditions in the following way:

“There is a growing demand for flexible mobility products in urban areas. Drive Now’s premium car sharing services are aimed precisely at this gap in the market”. ( BMW, 2011)

At this point, the focal actor clearly defined the market change and the desire to capture this opportunity. However, the firm lacked technical knowledge on mobility service operations, hence it began to search for a partner to create a joint venture for mobility services. At the same time, SIXT AG, a mobility business in Europe that has been in the car rentals since the mid-1900s, was seeking new opportunities. This firm is a pioneer in car sharing technology and operates across Europe. After a series of collaborative negotiations, the focal actor and SIXT AG formed a strategic partnership to create a car-sharing venture to meet urban travel demands.

#### 4.1.2 Interessement

The mobility services were launched in 2011 and were widely accepted by customers, with 10,000 users registering for this service within a year. To offer better a customer service and to reach wider customer segments, the mobility services provider needed to offer more customized services. The focal actor alone could not design and offer these services, needing different business partners who were already offering or were capable of designing these services. Hence, the mobility service network began to evolve by engaging with a range of

actors for different business needs. This study observed that the focal actor negotiated with 30 actors (see table 4) to join the network during 2012-2018 (January).

#### **Insert Table 4**

##### 4.1.3. Enrolment

The study identified 30 actors engaged in the mobility network (table 5), who performed specific roles assigned by the focal actor. For example, Sixt AG agreed to provide fleet management technology and Green Maintain Energy provided renewable energy certificates for the fleets. Some actors were assigned to integrate these mobility services into their business portfolio, such as Arriva in Denmark, and Modalizy and XXIImo in Belgium. Two city councils from London and Hamburg also joined the mobility service network as part of a sustainable mobility service strategy. To make these mobility services more attractive to the customer, the focal actor collaborated with 2 retail market businesses, McArthurGlen Designer Outlet and Rewe supermarket. These firms offer discounts and shopping vouchers for mobility service users.

In 2018, the focal actor announced a partnership with two start-up firms in Germany. The first, Chargery, with its innovative battery technology, charges BMW cars within 30 minutes. The second firm, Woshapp, offers cost-effective cleaning services for BMW vehicles. The focal actor only selects partners who have market experience and/or firms with innovative technology or solutions.

#### **Insert Table 5**

##### 4.1.4 Mobilization

The mobility service network expanded by aligning with a wider range of actors. At the time of this study, the focal actor was aligned with 30 actors for various business needs. At this stage of network development, the focal actor's role is to monitor the interests of the actors and to

stabilise the network. The study did not find any breaks in the network or the loss of interest in the mobility services on the part of any of the actors. However, due to the early phase of the network, it is not yet clear whether the network is generating continued success and how the network will evolve in the future.

#### 4.2 Actors' positions in the network

This study clustered all the actors into 4 groups, based on the positioning of the firms in the mobility services network (classification adopted from Sadeghian *et al.*, 2012). Table 6 summarises the clustering of actors according to their position in the mobility service network. These are *demand-side actors*, *regulatory actors*, *supply-side actors* and *co-branding actors*. Supply-side actors are categorized in a more detailed way due to their variety.

#### **Insert Table 6**

*Demand-side actors* are the mobility service users, who not only use the mobility service but also provide feedback about service quality and issues through various platforms such as the mobile application, the website and surveys. The mobility service provider uses this data to enhance service quality and customer experience. The mobility service network had one million customers by the end of 2017 (BMW annual report 2017, P.64). The main reasons for the growing number of users for mobility services are their convenience and low price. Some customers have reviewed the service on the Trustpilot website<sup>1</sup>.

#### *Review 1*

*"...more convenient and cheaper than an Uber, and sometimes even cheaper than getting a bus. I've recommended it to a number of friends."* (Trustpilot, 2018)

#### *Review 2*

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<sup>1</sup> Trustpilot.com is a consumer review website founded in Denmark in 2007, which hosts reviews for businesses worldwide. The site is free for consumers and it offers freemium services to the companies. Trustpilot has offices in New York, Denver, London, Copenhagen, Vilnius, Berlin and Melbourne, employing more than 700 people and receiving nearly 1 million new posts each month. The firm relies on its users, reviewed business and software to detect questionable reviews, which can be removed if they violate Trustpilot's content guidelines.

*“Well researched and implemented system. Cars are clean and the app is intuitive, including the damage report system.” (Trustpilo, 2018)*

*Regulatory actors* are the local authorities. Local authorities are responsible for providing permits and parking spaces for mobility services. Two regulatory actors were identified in the mobility service network: Islington, Hackney and Haringey councils (London), and Free and Hanseatic City of Hamburg (Germany). These regulatory actors have different motivations for joining the network. For example, Islington, Hackney and Haringey councils’ Ben Plowden, Director of Strategy and Planning for Surface Transport at Transport for London, commented about mobility service as:

“In the next 20 years that’s going to rise to 35 million and so we have to respond and find some way of dealing with that. The Mayor and Transport for London have long supported the growth of car sharing schemes across London, as they can help encourage more alternative travel choices.” (Brigstock, 2014)

Hamburg city council has a different motive for supporting mobility services. Free and Hanseatic City of Hamburg Mayor Olaf Schulz, comments:

"Hamburg is preparing for future mobility with state-of-the-art technologies. The cooperation with the BMW Group will play a major role in systematically expanding e-car-sharing services. Integrated e-car-sharing, combined with classic public transport solutions, will ensure that future urban passenger transport offers greater flexibility and capacity, even at peak times." (BMW PressRelease, 2017, paragraph 3)

*Supply-side actors* provide technology, fleet maintenance services and infrastructure facilities for mobility services. Altogether 21 actors were identified in the supply side actor position. This group consists of 3 types of actors, including vehicle suppliers, infrastructure operators, and transport operators (as detailed in Table 6). *Vehicle service suppliers* (11 actors) provide services such as customer registration, communication and parking solutions. Eight actors are in this position in the mobility services network. The focal actor selected partners who had pioneered in the market with their business solutions. For example, Easypark offers parking-related solutions for mobility service. According to Fredrik Ellsäter, CEO of DriveNow in Sweden

“If our car sharing service is to work as smoothly as we want it to, parking fees must be handled automatically. EasyPark is the company that has made the most progress in the market, with a fully automated solution that makes this possible for us.” (Laroussi, 2015)

Five actors provided services related to infrastructure, and they are considered as *infrastructure operators*. These actors provide parking facilities and fleet management services for mobility services. Europ Assistance Italia S.p.A joined the mobility service network in 2015. Luca Pelizzari, Head of Automotive of Europ Assistance Italia S.p.A, expressed his reasons for collaborating:

"We are very proud to be an active part of modern and sustainable mobility projects. We are certain that our ability to intervene, the specialization in all types of rescue and the continuous search for innovative solutions will meet the needs of this new and prestigious partner." (Europassistance, 2016) (Original text in Italian).

Five *transport actors* are engaged in transportation-related services. These are firms who are already in the mobility service business, including car rentals and taxi services. These actors integrate the focal actor's mobility services into their business portfolio to increase business and meet market demand. For instance, Arriva, a public transportation company in Denmark joined the mobility service network in 2015. In their media announcement, Nikolaj Wendelboe, Managing Director of Arriva, declared:

“DriveNow is the most ambitious and innovative public transport solution we have seen. With the 400 city cars, we tie Copenhagen and public transport together in a new way, giving citizens a flexible, coherent and simple travel experience.” (Arriva launches extensive city car concept in Copenhagen, 2015, paragraph 3).

OP financial also expressed similar motives for this partnership. Masa Peura, Director of new business areas, announced:

“We are happy to announce the co-operation with DriveNow and further expand our range of mobility services. Our strategy is very future-oriented, and we want to build it together with the best partners. Based on these principles we believe that DriveNow is the right car sharing service partner for us and our customers” (Nauman, 2017).

This study identified a new group of actors in the mobility services network. Seven actors engage in promotional activities for mobility services. These firms promote mobility services

through their website and business premises. As a mutual benefit, these companies' customers receive free registration for mobility services.

As an example, Local Tennis Leagues joined the mobility services network. This firm described the partnership as follows:

“We're delighted to welcome DriveNow into the Local Tennis Leagues family. The modern flexible car club and the modern flexible way to play tennis.” (Local Tennis Leagues, 2017,para.1).

Thus, a framework for a mobility services network was created from reviewing the data through the actors involved in the focal firm's mobility service network and their positions (See fig 1).

**Insert Figure 1**

## **5. Discussion**

Through document analysis, the study reveals the evolution of BMW's mobility service and the position of the actors involved in the network. The process of deploying mobility services was reviewed using the ANT lens to see who the actors were and what their positions in the network were. This study adopted the actor-network theory to explain the evolution of this mobility service network. This is the first study to adopt the actor-network theory to illustrate network evolutions. By evaluating the types of actors and their key activities in the mobility service network, this study extended knowledge on cooperation between actors and how these help to reach the goals of the network. The discussion is presented in two sections, the evolution of the mobility service network, and the position of the actors in the network, each responding to the two related research question.

### **5.1 Car manufacturer's efforts in building the mobility service network**

BMW's mobility service network evolved through 4 stages (Actor-network theory lens). The mobility service network was launched in 2011 to meet the urban travel demand.

Another factor was the rise in alternative urban mobility solutions from Uber and Ola in Europe and America, forcing the focal actor to address the problem and the competitive position and look for alternative solutions for urban mobility services. This process of sensing customer demand and competitors' strategic movements is referred to as *Problematization* in the ANT (Ezzamel, 1994). To compete with mobility service providers in the market, in 2011 the focal actor announced a mobility service venture called DriveNow, with Sixt AG as its technological partner. Sixt AG was already in the vehicle rental services business, pioneering car-sharing technology. The focal actor successfully engaged Sixt AG in collaboration and technology exchange. This argument is supported by the findings of Carrington and Johed (2007), who stated that actors need to convince others to subscribe to their own view by showing they have the 'correct' solution, and work towards imposing their definition of a problem onto others.

After defining the problem and identifying the possible solution for the urban mobility issue, the focal actor started negotiations with the different actors regarding the activities and services required by the network, known as *Interessement*. The focal actor needs to convince others that they will achieve their own goals when they join the network (Connell *et al.*, 2014), and also create a bond between the various actors' interests and support them. (Lowe, 1997) addressed this phase, in which various firms' interests are linked together and strengthened. To extend the services and increase customer experience, the service provider should align with third parties. (Van *et al.*, 2014), but it is also important that the aligned partner benefits from the network (Holmberg *et al.*, 2015). Singleton and Michael (1993) stated that in order to succeed in the enrolment phase, the focal actor needs more than just one set of actors imposing their will on the others. they observed increase in customer numbers and positive reviews of service quality are mainly due to more flexible services and the additional services integrated by the actors.

Even though these actors have different interests and expectations, the network is built and expanded with 30 active actors (Known as the *enrolment* phase). Hilgert *et al.* (2016) suggest mobility services are highly complex in nature, requiring the collaboration of many partners. Koglin *et al.* (2017) express the same view, stating that several actors need to collaborate for a scalable integrated mobility service to materialize. This is a crucial stage for the success of the network, when the focal actor aligns actor positions in the network based on their knowledge and resources. The network is built up based on an agreement among the different actors concerning their interests and how they can be aligned with the focal actor (Alcouffe *et al.*, 2008).

The focal actor's mobilization phase is in progress, which means that other external (allies) actors are still joining the network to support the mobility services. At this point, the focal actor needs to monitor the interest of the various actors to stabilise the network (Mouritsen *et al.*, 2001). According to Connell *et al.* (2014), mobilization occurs as allies move to support the network. This process is not without its problem, and controversies can make actors unenroll. However, at the time of writing this paper the acquired data did not reveal any change in the network; in other words, all the actors remained in the network and no controversies were apparent.

Hence, these findings revealed new insights into the mobility service by employing an actor-network theory. This study can inspire studies to adopt ANT as an analytical framework to produce knowledge

## 5.2. Actors' positions in the mobility services network

A new group of actors has been identified in the network, called co-branded actors in this study, comprised of seven actors who integrate mobility services into their business category. This cooperation enhances visibility and attracts new customers. These actors promote mobility services through their website campaigns and on their business premises. As



a mutual benefit, these actors' clients can register free for the mobility services. This collaboration considerably increased the number of customers in Austria, Germany, and Denmark. These findings deviate slightly from the earlier study by Sadeghian *et al.* (2012), in which the author placed actors into 3 groups in the mobility service network. Our findings add one more category to Sadeghian *et al's* (2012) classifications. One possible explanation for the presence of co-branding actors in the mobility service network is that BMW, as a mature car manufacturer attempting to move into a completely new business line, needs promotional partners to penetrate the market faster. Grębosz-Krawczyk and Pointet (2017) stated that co-branding primarily enables partner companies to accomplish the objectives closely linked to the area of brand management. The study findings are also supported by Smirnova and Moreva (2015), where the authors claimed that a co-branding agreement between a small company and the leading companies can only exist in a highly competitive market.

The study found 30 influential actors, mapping them according to the categories described in Sadeghian *et al.* (2012). Regarding the actor's activity in the network, the study found that the network expanded very quickly and was widely accepted by customers. Nearly 0.8 million users (*demand side*) had registered in the mobility service network by the year 2017. The demand side actors use the mobility services and provide feedback on service experience, issues and service quality. The focal actor collects the data from customers through various platforms like social media, websites and mobile applications about users' experiences, analyzing them to develop better services. As the network expanded so quickly, this created a demand for additional, more customized services. As part of the network expansion, the focal actor collaborated with two local authorities, one in London and one in Hamburg . This alignment is mutually beneficial for the actors. From the regulatory actor perspective, the key interest in joining the mobility service network is to reduce the volume of private vehicles and support sustainable mobility solutions. The study finds that this mutual co-operation between

private and local authorities also helps to gain customer acceptance and trust in mobility services. Many scholars have advocated this kind of co-operation, for example, Cohen *et al.* (2014) stated that an optimal relationship between the service provider and the local government is vital to achieving common objectives. Sochor *et al.* (2015) extended this view further, stating that to create integrated mobility solutions, close co-operation is needed between public and private actors. This argument was also supported by Van *et al.* (2014), who stated that support from a city's top management is vital for establishing broad partner ecosystems and successfully implementing integrated mobility solutions. This finding suggests that mobility services providers need strong, close cooperation with local governments not only for legal permits and infrastructure access, but also because it influences user perception of mobility services.

The results identify another group of actors, who provide technology, fleet management and infrastructure facilities, and integrate added value services for mobility services. These were mapped as supply-side actors in the network. The role of these actors greatly influences the success of mobility services. Mobility services providers need to carefully consider service design and attributes, and it requires innovative and dedicated service providers to meet goals (Karlsson *et al.*, 2016). Warwick *et al.* (2017) also stated that a diverse range of actors need to cooperate to perform the different activities: technology providers, mobile communication providers, payment processors, public and private transportation providers and local authorities. The network was observed to contain heterogeneous activities ranging from vehicle washing to automatic parking payment services.

The result suggests that the mobility service provider needs to collaborate with the demand side, and the regulatory and service side actors. This study revealed a new actor category, called co-branding actors, which has not been discussed clearly in previous research and is a novel contribution to the research on mobility service design.

## **6 Conclusion**

This study contributes to research on mobility services by revealing that a car manufacturer's partner network emerges and evolves in the early years of the mobility service business. The study framed the actor-network of mobility services, which can be used to understand the evolution of a mobility service from a car manufacturing firm's perspective. This framework explains the focal actor's engagement, co-operation and activities during the networks' early stages. Other actors' activities and positions in the network were traced through document analysis, press announcements and actors' websites. The advantage of actor-network theory in explaining and implementing mobility services is also demonstrated, identifying the network links between actors and their networked dependencies.

This paper creates and develops an approach to understanding mobility services using ANT concepts. This analytical framework both supports emergent views of representative actors and offers a novel account of their interactions in the network. Instead of going it alone in the market, the focal actor collaborates with multiple actors to access their market knowledge, technology, R&D and infrastructure, through a course of negotiations around the concept of mobility services. The framework presented in the study helps to understand the position of the actors and their contribution to the service design network. Regarding ANT, this study contributes some knowledge in general and, more specifically, knowledge about its deployment in mobility service research.

The findings of this study have some practical implications regarding the understanding of different actor's interests during the course of mobility service design. First, the focal actor needs to recognize and understand customer heterogeneity and the business interests of the actors. They must negotiate to exchange resources and capabilities to fulfill their business needs. Second, they need to draw attention to the issues involved in the service network. Third,

the interests and activities are often only formulated and articulated in the course of negotiations on very specific design features. Since other actors are not the initiators of this network, the car manufacturer as the focal actor needs to conceptualize the role and activities of the different actors. In some instances, the cooperation between actors is based purely on the financial perspective. The focal actor always looks for cost-effective solutions and there is the probability of excluding existing actors and enrolling new ones.

Although this study focuses on new insights into mobility services, it has some limitations which opportunities for further research are. The single-case design, the choice of the case firm and the early phase in mobility services diffusion in the industry limit the generalizability of the findings. The firm choice was purposeful, as learning from an early adopter of mobility services may be particularly beneficial for followers. The findings are based on documents that are limited by the assumptions of their creators and, therefore, should be considered as a preliminary attempt to explore mobility services through the lens of actor-network theory. Effort were made to use various documents to enable triangulation across document types and sources and thereby improve the research validity.

More research is needed to understand the evolution of mobility services. This study opens a discussion on how actor engagement makes a difference and how different types of actors support the heterogeneous network of mobility services. More research is encouraged in new directions such as managerial experience during networking. This is the first attempt to bring new insights into mobility service development. We believe this result could inspire researchers to apply ANT to other kinds of mobility services contexts to provide new knowledge.

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## Tables and figures

**Table 1** Summary of key literature on implementing mobility service concepts

Author	Context, method, and data	Study summary	Research gap
Cohen <i>et al.</i> (2014)	Conceptual study, based on empirical data for car sharing, ridesharing and bike-sharing business models.	<p><i>Focus:</i> The relationship between service providers (agents) and local governments (principals) to achieve sustainable mobility.</p> <p><i>Main results:</i> Agency theory was used to explain the relationships between different actors and the degree of alignment. Private and public models are fraught with conflicts. A move toward merit-based business models may offer a more optimal alignment between the service provider and local government objectives.</p>	<p>This study opens up discussion and the research topic of public and private collaboration in delivering shared mobility services.</p> <p>What is the relationship between municipal sustainable objectives and interactions with the private sector?</p> <p>Proper alignment of incentives to achieve sustainability objectives while allowing for sufficient profitmaking with private sector partners is an important area of research.</p>
Sochor <i>et al.</i> (2015)	Six-month field operational test (FOT) in Sweden, where 195 participants tested the UbiGo mobility service for everyday travel.	<p><i>Focus:</i> Identification of matches and mismatches between the expectations and experiences of three stakeholder groups: users (FOT participants–customers), commercial actors (mobility broker and service providers) and society.</p> <p><i>Main results:</i> to create integrated solutions, truly collective transport must involve close cooperation between public and private actors and the consideration of at least the three, sometimes conflicting, stakeholder perspectives.</p>	<p>New business models are needed to address the challenges associated with future integrated urban mobility solutions.</p>
Terrien <i>et al.</i> (2016)	A case study on public and private experiences with five one-way car-sharing services in Europe and the United-States. Interview data from both the public and the private sectors.	<p><i>Focus:</i> Public and private experiences of car-sharing services</p> <p><i>Main results:</i> Proposes a systematic and balanced public-private approach to foster transportation innovation management. Recommends that public and private actors should co-manage innovation since pilot projects lack certainty and require risk management.</p>	<p>Specific analysis tools should be developed and employed in pilot projects, as they enable local governments to build knowledge, skills and new project management capabilities.</p>

Sochor <i>et al.</i> (2016)	Data on travel behavior and related changes on UbiGo services were collected in Sweden	Focus: Trial and evaluation of mobility services.  <i>Main results:</i> Key service attributes such as the transportation smorgasbord concept, simplicity, improved access and flexibility, convenience and economy. Successful implementation of MaaS requires careful consideration of service design and attributes (service providers, price models, invoicing, support functions, etc.), and it requires innovative and dedicated service providers committed to the challenge.	This study emphasized the fact that MaaS requires cooperation and collaboration between actors such as the public and the private sectors, but it did not provide knowledge on how this collaboration can work with other partners.
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Source: authors' own elaboration based on the cited authors

**Table 2** Summary of data types

Document type	No of documents
Annual reports (2007-2017)	11
Press releases	10
Media information	2
News (websites)	2
Case studies	1
Blog	1
Web information	4
Online Auto news	17
Total	48

**Table 3.** Categories of ANT stages, a listing of codes and example quotes from the document data

<p>Problematization</p>	<p>Profit loss Sales drop</p> <p>New strategy Customer demand Change in urban travel behavior</p>	<p>The focal actor announced a 14% decrease in worldwide sales for September 2008. In Western Europe, the passenger car market experienced sharp volume contraction. The number of new registrations fell by approximately 8% to 13.6 million vehicles (BMW, 2008, Pg18)</p> <p>“...to strive for organic growth in the core line of business, the BMW Group will also engage in new and profitable areas of activity throughout the automotive life-cycle and all the way along the value-added chain” (Bmw Ag, 2007)</p> <p>“As a mobility provider, the BMW Group is not simply an automobile manufacturer. There is a growing demand for flexible mobility products in urban areas” - Ian Robertson, Member of the Board of Management of the BMW AG for Sales and Marketing</p>
<p>Interessement</p>	<p>Mobility services Fleet management Experience in car rental</p>	<p>In the middle of 2008, SIXT pioneered innovative car sharing when it started up its SIXTI Car Club in Berlin. Together with BMW, we have now taken this concept a stage further to become DriveNow</p> <p>“... The wealth of experience which we have already gained in car rental processes and fleet management systems will enable us from the outset to offer our DriveNow customers complication-free mobility combined with excellent customer service, the basis for a sustainable and profitable business model.” Detlev Pättsch, Member of the Sixt AG Board of Management</p>
<p>Enrolment</p>	<p>Common goals Market experience Business expansion service integrations strategic partner customer experience customer demand</p>	<p>“...we have nothing against cars. There is no need to own three cars per household, especially in Brussels where there is such an integrated and all-around mobility solution. What we are doing with DriveNow and this intermodal solution is probably one of the most efficient ways forward with the infrastructures currently in place”. - Philippe Lefrancq, Co-Founder at Ahooga</p> <p>“Working with BMW to support its sustainability efforts is a perfect fit for Green Mountain. BMW’s DriveNow program amplifies the environmental impact by offering consumers the opportunity to drive an electric vehicle that also supports renewable energy”. - Scott Hart, president of Commercial Services for Green Mountain</p>
<p>Mobilization</p>	<p>Strategic development Future plans</p>	<p>“We have achieved extraordinary success with DriveNow over the past seven years—thanks to the efforts of the DriveNow employees and the excellent</p>

	Cooperation with partners City partners Franchise	<p>cooperation with our joint venture partner, SIXT. SIXT will remain a strong partner for us in the future. Our aim is to win one hundred million customers for our premium mobility services by 2025. With DriveNow as a wholly-owned subsidiary, we have all the options for the continued strategic development of our services in our hands. Our experience with mobility services supports our development of future autonomous, electrified and connected fleets”(BMW Group, 2011)</p> <p>“In 2017 our customers drove over eight million kilometers (five million miles) with the DriveNow electric fleet—that is equivalent to driving around the globe more than 200 times on electric power. DriveNow not only reduces traffic and improves the parking situation in urban areas, but it is also supporting the breakthrough of electromobility”. - Sebastian Hofelich, DriveNow Managing Director</p> <p>“We look forward to working with our franchise and city partners to continue actively shaping urban mobility in a sustainable manner”. - Sebastian Hofelich, DriveNow Managing Director</p>
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**Table 4** Actors and year enrolled in the network

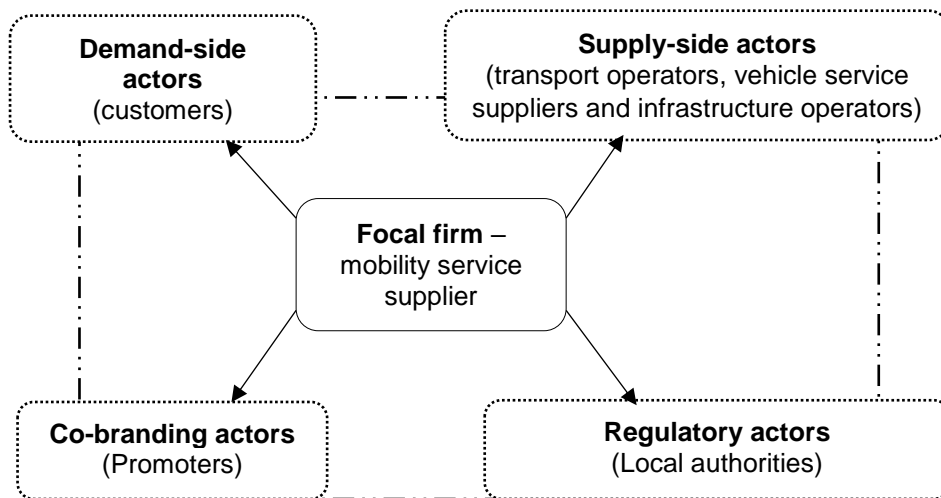
Actors	Year
Sixt AG, Mobility services users	2011
Green Mountain Energy Company, MyCityWay	2012
Europ Assistance Italia S.p. A.	2013
Islington Hackney and Haringey councils, Twilio, McArthurGlen Designer Outlet, and Rewe supermarket	2014
London City Airport, Vodafone, EasyPark, Alphabet, Arriva, and ARBÖ Club Card	2015
TOTAL, Deutsche Post, Moovit, and Hype Life	2016
Free and Hanseatic City of Hamburg, OP Financial Finland, Chargery, Woshapp, Modalizy and XXImo, Ahooga, PHIZZ, Local Tennis Leagues, Fragters, and ARBÖ Club Card	2017
E.ON	2018
<b>30 PARTNERS</b>	<b>8 YEARS</b>

**Table 5** Actors and their main task in the mobility service network

<b>Actor</b>	<b>Role in the network</b>
Sixt AG	Technology for the fleet management system
Islington Hackney and Haringey councils	Provides on-street parking spaces
London City Airport	Parking spaces and service information
Free and Hanseatic City of Hamburg	Provides charging infrastructures
Green Mountain Energy Company	Provides Renewable Energy Certificates (RECs).
TOTAL	Digital payment methods for fuel
Europ Assistance Italia S.PA	Roadside assistance such as the replacement of punctured tyres, the replacement of batteries and the phone fix service in Italy
Deutsche Post	Provides a digital identification process to verify both a driver's identity and their driver's license
OP financial	Manages DriveNow services in Helsinki
Chargery	Provides on-demand battery charging services in Berlin
Woshapp	Provides car washing services in Stockholm
Twilio	Provides mobile communication service like SMS
Vodafone	Offers SIM chips which link BMW with its vehicles and provides customers with access to innovative in-car services such as Online Services, a 24/7 personal concierge service for drivers, and an emergency call function.
EasyPark	Provides technology for parking locations and payment
MyCityWay	Provides infotainment services including weather, traffic, parking, nearby events, dining and nightlife options, public transit updates, etc.
Moovit	Integrates DriveNow services into their mobile App.
McArthurGlen Designer Outlet	Shopping vouchers for DriveNow customers and free parking for 30 minutes on their premises
Rewe supermarket	Discount on purchases and ten minutes' free parking
Modalizy and XXImo	Integrates DriveNow services in their business portfolio
Ahooga	
Alphabet	
Arriva	
PHIZZ	Promotes DriveNow services through their website
The Local	
Hype Life	
E.ON	
Local Tennis Leagues	
ARBÖ Club Card	
Fragters	
Users	Utilizes mobility services and provides feedback on service quality

**Table 6** Categories of actors in the focal firm’s mobility services network

<b>Category</b>	<b>Actor</b>
<b>Demand-side actors</b>	Mobility service users: consumers
<b>Regulatory side actors</b>	Islington Hackney and Haringey councils Free and Hanseatic City of Hamburg
<b>Supply-side actors:</b> - Vehicle service suppliers	Deutsche Post Sixt AG Woshapp Twilio Vodafone EasyPark MyCityWay Moovit Green Mountain Energy Company Chargery
- Infrastructure operators	London City Airport TOTAL McArthurGlen Designer Outlet Rewe supermarket Europ Assistance Italia SPA
- Transport operators	Modalizy and XXImo Ahooga Alphabet Arriva OP financial
Co-branding actors	PHIZZ The Local Hype Life E.ON Local Tennis Leagues ARBÖ Club Card Fragters



**Fig 1** Framework for the mobility service network

**Keywords:** Actor-network theory; Mobility services; Manufacturing; Car sharing; service innovation; co-branding.

**Paper type:** Research paper