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A Systematic Literature Review of Carsharing Research: Concepts and Critical Success Factors

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Concepts in Carsharing Research					
Market Analysis	Location	Travel Behavior	Information Systems	Electric Carsharing	Sustainability

Critical Success Factors of Carsharing Services				
Population Density	Shorter Access Distances to Carsharing Locations	Lower Rates of Car Ownership	Areas with Limited and Expensive Parking	Pedestrian and Bike Friendly Areas
Transit Accessible Areas	Mixed-Use Developments	Cooperation with Relevant Stakeholders	Incentives to Members	Implementation of Information Systems

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ABSTRACT *This paper aims to examine critical success factors of carsharing services by conducting a literature review. In order to give an overview of existing carsharing research articles, a conceptual structuring of the topic of carsharing is created. Hereby, 130 articles are analyzed, identifying 6 key concepts, i.e., market analysis, location, travel behavior, information systems, electric carsharing, and sustainability. With regard to the defined parameters of the literature review, the concept of market analysis reveals the strongest interest in carsharing research counting approximately half of the reviewed literature. However, the other concepts have received considerable attention in the past few years, which is why the interdisciplinarity level of carsharing research has grown substantially. Since carsharing is a growing trend in practice as well as in research, we analyze the background characteristics associated with the growth and success of carsharing services by deriving critical success factors from the literature. The critical success factors are discussed for practical implications and recommendations for further research are given.*

1. Introduction

An increasing number of research studies investigate the current topic of carsharing, which is regarded as a transportation alternative to private car ownership. Carsharing provides individuals with cars from a fleet on an as-needed basis (Fan, 2013; Shaheen, Cohen, & Roberts, 2006) and is considered as a short-term car rental service (Le Vine, Lee-Gosselin, Sivakumar, & Polak, 2014b; Morency, Trépanier, & Martin, 2008; Tal, 2009), allowing members to gain the benefits of private car use without the costs and responsibilities of ownership (Costain, Ardron, & Habib, 2012; Shaheen, Cohen, & Chung, 2009). Referring to Prettenthaler and Steininger (1999), carsharing is cost saving compared to ownership, if an individual drives less than approximately 15,000–18,000 kilometres per year. Concerning the ongoing urbanization, carsharing can additionally help to reduce environmental pollution and to overcome parking pressure issues (Habib, Morency, Islam, & Grasset, 2012; Shaheen & Cohen, 2012, 2013). However, compared to ownership, carsharing has the disadvantage of less convenient vehicle access (Shaheen, Sperling, & Wagner, 1999), marking a major challenge for carsharing services.

From an economic perspective, the worldwide number of carsharing members and vehicles have grown considerably over the last several years (Figure 1). According to Navigant Research (2013), worldwide revenue from carsharing services will continue to grow from approximately $1 billion in 2013 to $6.2 billion by 2020.

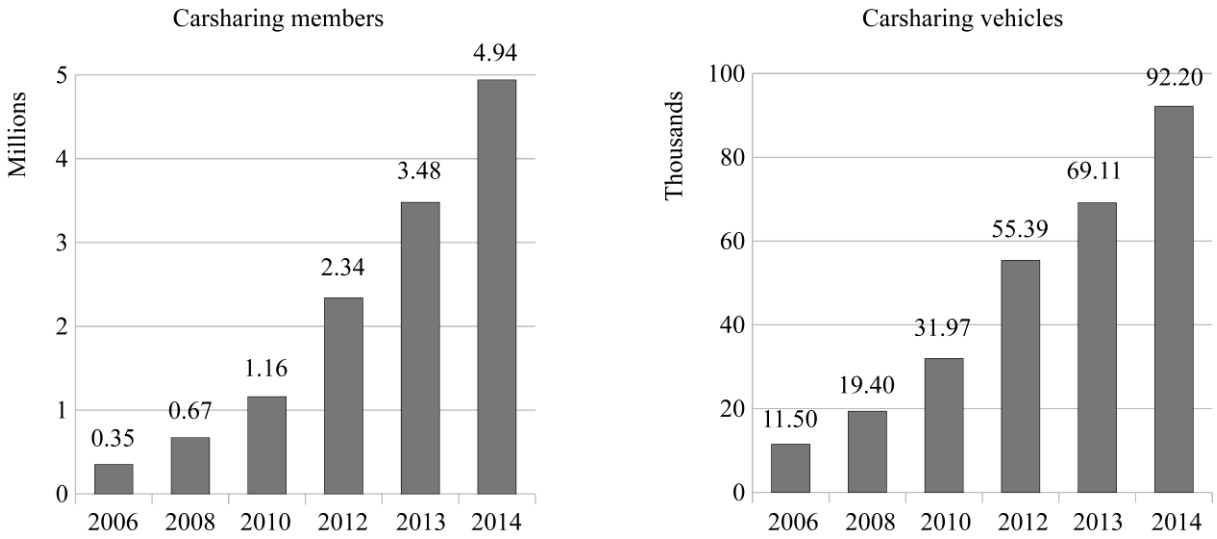

Figure 1. Worldwide growth of carsharing services.
Source: Frost & Sullivan (as cited in Le Vine, Zolfaghari, & Polak, 2014c, p. 3)

Despite these growth predictions, carsharing is often still referred to serve niche markets (Coll, Vandersmissen, & Thériault, 2014; Green, Skerlos, & Winebrake, 2014; Shaheen & Cohen, 2013; Barrios & Godier, 2014). With regard to Zhou (2014), "the success of a carsharing program relies heavily on identifying and penetrating into niche markets" (p. 318). In this context, critical success factors of carsharing services have been discussed by several researchers (e.g., Andrew & Douma, 2006; Catherine, Faghri, Trick, Fortunaot III, & Suarez, 2008; Ciari, Balmer, & Axhausen, 2009; Correia & Antunes 2012). However, a review of the literature suggests that a holistic structuring of the topic of carsharing with a depiction of critical success factors has not yet been addressed.

In practice as well as in research, the topic of carsharing is becoming more and more important. This paper makes a theoretical contribution by creating a conceptual structuring of the topic and uncovering key concepts, i.e., market analysis, location, travel behavior, information systems, electric carsharing, and sustainability. We give an overview of the current research in the carsharing area by

conducting a literature review. From the identified literature, critical success factors are derived and practical implications for carsharing services are discussed. We explore the following two research questions:

- Which concepts can be identified from the carsharing research literature?
- Which critical success factors should carsharing services take into consideration?

This paper is structured as follows: First, the underlying methodology is described and the development of carsharing research is outlined. After presenting the identified concepts in the field of carsharing research, we examine critical success factors of carsharing services derived from the literature review and give implications for practice. Finally, limitations and directions for further research are presented in a conclusion.

2. Research Methodology and Conceptual Basis

To give a holistic overview of the current research in the carsharing area, a literature review was conducted. Following Webster and Watson (2002), an effective review "creates a firm foundation for advancing knowledge" and "facilitates theory development, closes areas where a plethora of research exists, and uncovers areas where research is needed" (p. xiii). The underlying methodology is based on the structured approach by Webster and Watson.

First, the following research databases were searched for relevant literature: ACM Digital Library, AISeL, Emerald, IEEE Xplore, INFORMS PubsOnLine, JSTOR, ScienceDirect, SpringerLink, Taylor & Francis Online, Transportation Research Board's TRID, Web of Science, and Wiley Online Library. We used "carsharing" and "car sharing" as search keywords, and intensively analyzed the literature for relevance. Only literature in the English language and with a strong focus on commercial carsharing was considered; literature referring to peer-to-peer carsharing, corporate carsharing, carpooling, ridesharing, bikesharing, etc. was excluded (for example, for a literature review on bikesharing see Fishman, Washington, & Haworth, 2013). Second, a backward and a forward search was conducted. The backward search was carried out by reviewing the references of the identified articles, and the forward search was performed using Web of Science to find further literature citing the articles. We identified 130 articles from 26 different journals and 11 conferences, published from 1999–2014 (see Appendix 1 for a full list of the journals and the conferences along with the number of publications). Third, as we read each article, a concept matrix was compiled, identifying six key concepts in the field of carsharing research, i.e., market analysis, location, travel behavior, information systems, electric carsharing, and sustainability (see Appendix 2 for a detailed categorization of the literature in a compiled concept matrix). Thus, the review was structured by synthesizing the literature and discussing each identified concept.

The concepts help to understand the development of various research subjects with distinctive focal points (Figure 2). The findings of the literature review show that most of the articles address the market situation of carsharing services (59 articles). Further areas of interest include location considerations (41 articles), travel behavior (33 articles), information systems (18 articles), electric carsharing (18 articles), and sustainability (9 articles). With regard to the years 1999–2002, most of the articles analyzed the carsharing market – the other concepts were side issues at this point: while travel behavior, information systems, and electric carsharing had been of little concern, location and sustainability were not in focus at all.

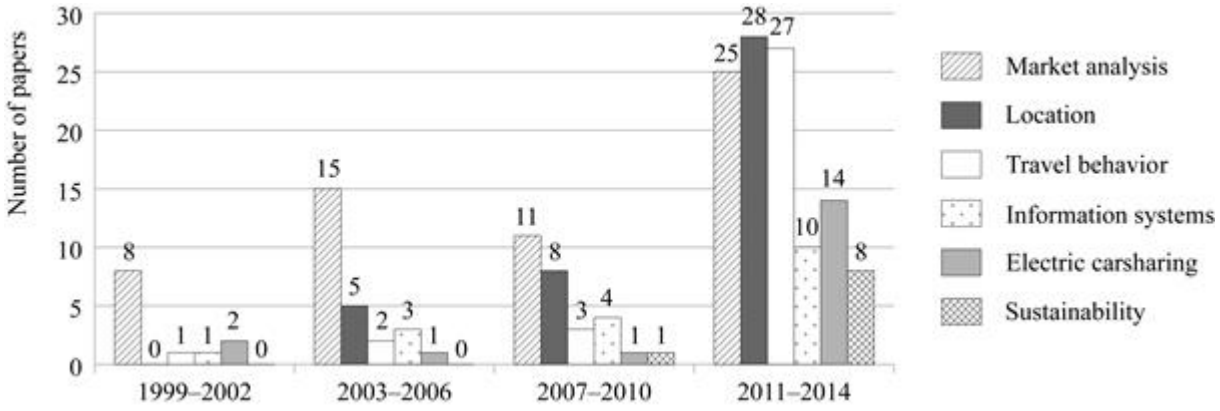

Figure 2. Concept development of carsharing research.

In the time periods of 2003–2006 and 2007–2010, these side issues gradually grew in importance – with a distinctive increase of location topics. Eventually, from 2011–2014, the side issues have received considerable attention, which is why the interdisciplinarity level of carsharing research has grown substantially in the past few years. At present, the market situation of carsharing services, location topics, and travel behavior are most discussed in carsharing literature, followed by information systems for carsharing services, electric carsharing, and sustainability. The concept development in Figure 2 also reveals that there is a growing trend toward carsharing research in general.

2.1. *The Concept of Market Analysis*

The first concept describes various aspects of the carsharing market such as the market potential of carsharing in an international scope, the impacts of carsharing, as well as market trends and the future development of carsharing. For example, Kato, Inagi, and Igo (2012a) analyzed the market potential of carsharing in four Japanese cities by conducting a survey focused on respondents' awareness and preferences of carsharing services. Rabbitt and Ghosh (2013) evaluated the market potential of carsharing in Ireland using multiple alternative scenarios which examine the geographic, financial, and environmental factors influencing carsharing adoption. Klincevicius, Morency, and Trépanier (2014) assessed the impact of carsharing on private car ownership in Montreal by analyzing information from Canadian census data, household surveys, and information on a carsharing service in Montreal. Further studies assessed the market potential of carsharing, for example, in China (Shaheen & Martin, 2010; Wang, Martin, & Shaheen, 2012), the United States (Andrew & Douma, 2006; Catherine et al., 2008; Duncan, 2011; Zhou & Kockelman, 2011), the United Kingdom (Le Vine et al., 2014b), France (Clavel, Mariotto, & Enoch, 2009), Germany (Firnkorn & Müller, 2012; Loose, Mohr, & Nobis, 2006), and Austria (Steininger & Bachner, 2014), as well as in a global context (Shaheen & Cohen, 2007, 2013). The majority of carsharing members are from North America and Europe, followed by Asia, Australia, and South America (Figure 3). In 2006, most carsharing members were from Europe, but Europe has now been overtaken by North America.

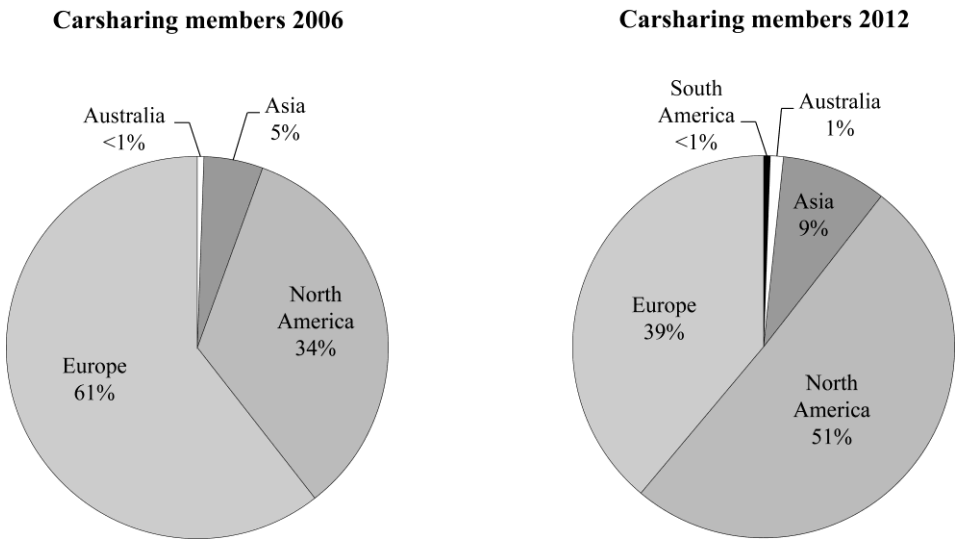

Figure 3. Percentage of carsharing members by continent. *Source:* Shaheen and Cohen (2012, p. 2)

There are numerous companies providing carsharing services all over the world (see Appendix 3 for an overview of carsharing services). The most successful carsharing providers are Zipcar and car2go – Zipcar with currently over 870,000 members and more than 10,000 vehicles (Zipcar, 2014), and car2go with over 600,000 members and more than 10,500 vehicles (Daimler, 2014). Both companies provide carsharing services in several countries in North America and Europe.

2.2. *The Concept of Location*

The concept of location addresses one of the main challenges for carsharing services: the relocation of cars. Three types of carsharing systems are distinguished: round-trip, one-way, and free-floating. In round-trip systems, members have to return a car at the station where they picked it up (Uesugi, Mukai, & Watanabe, 2007). One-way systems allow members to pick up a car at one station and return it to a different station (Jorge, Correia, & Barnhart, 2013), while free-floating systems are operating without any fixed stations (Firnkorn, 2012). One-way and free-floating carsharing systems are causing car imbalances across the stations and locations of the cars (Barth, Todd, & Xue, 2004b; Correia & Antunes, 2012; Jorge & Correia, 2013). The imbalance of cars attributes to scholars' efforts in trying to optimize the relocation of cars (Clemente, Fanti, Mangini, & Ukovich, 2013; Febbraro, Sacco, & Saeednia, 2012; Kek, Cheu, & Chor, 2006; Kek, Cheu, Meng, & Fung, 2009). For example, Kek et al. (2006) developed a relocation simulation model and came to the conclusion that relocation can generate cost savings without lowering the level of service for users. Barrios and Godier (2014) explored the trade-off between fleet size and hired vehicle redistributors by using agent-based simulations of carsharing services with zero, periodic, and continuous redistribution. Further studies investigated the optimization of carsharing locations (Rickenberg, Gebhardt, & Breitner, 2013) and the role of parking requirements (Engel-Yan & Passmore, 2013; Millard-Ball, Murray, & Schure, 2006).

2.3. *The Concept of Travel Behavior*

This concept examines the impact of carsharing on several dimensions of travel behavior including attitudes of carsharing members, motivations of carsharing usage, and frequency of usage. For example, Costain et al. (2012) presented an analysis of a case study with a carsharing service in Toronto, Canada, to enhance the understanding of members' behaviors like attitude towards the environ-

ment, attitude towards safety, frequency of usage, etc. Ohta, Fujii, Nishimura, and Kozuka (2013) conducted a survey in Japan targeting driver's-license holders to investigate the acceptance of carsharing. To explore the motivations of carsharing usage, Schaefers (2013) performed 14 personal in-depth interviews with members of a carsharing service in the United States and presented the results on the basis of a qualitative means-end chain analysis. Another example is the study of Fatmi and Habib (2014) who developed latent class models in order to analyze the travel behavior of carsharing members in Halifax, Canada. Several other studies examined the motivations of carsharing usage (Chatterjee, Andrews, Ricci, & Parkhurst, 2013; Douma & Gaug, 2009) and the frequency of usage (Habib et al., 2012; Morency, Trépanier, & Agard, 2011; Morency, Habib, Grasset, & Islam, 2012; Sioui, Morency, & Trépanier, 2013).

2.4. *The Concept of Information Systems*

The concept of information systems in the context of carsharing examines various technologies such as intelligent transportation systems, geographic information systems, and information infrastructures. With regard to intelligent transportation systems, for example, Barth, Todd, and Shaheen (2003) investigated different car access methods, i.e., lockbox, common key, and smart card access, by presenting a trade-off between security and costs, as well as user convenience and costs. Further studies investigated wireless and mobile information systems, suggesting that Wi-Fi is a suitable communication technology for carsharing in urban areas (Chen & Regan, 2009) and providing insights into the usage of mobile devices such as smartphones for carsharing (Concas, Barbeau, Winters, Georggi, & Bond, 2013; Kasper, Kühn, Oswald, Zenger, & Paar, 2013; Lee, Nah, Park, & Sugumaran, 2011). In view of geographic information systems, Celsor and Millard-Ball (2007) conducted a geographic information system-based analysis of a carsharing service in Austin, Texas, presenting a tool that analyzes the neighborhood characteristics of existing carsharing locations. Coll et al. (2014) also used a geographic information system to perform a spatio-temporal modeling of the number of carsharing members in Québec City from 1996 to 2008 to assess and discuss the market potential in this area. Regarding information infrastructures, Khanna and Venters (2013) carried out a case study of the development of an information infrastructure in Berlin. The purpose of this particular information infrastructure was to develop a sustainable mobility service, which integrates electric carsharing into the public transportation system.

2.5. *The Concept of Electric Carsharing*

Electric car usage is considered to be capable of reducing carbon dioxide (CO_2) emissions (Hinkeldein, Hoffmann, & Schönduwe, 2012), which is why electric carsharing is predicted to increase in the near future (Shaheen & Cohen, 2013). However, CO_2 emissions can only be reduced substantially on condition that electricity is produced from renewable energy sources. According to McKinsey's electric vehicle index that assesses a nation's readiness to support an electric vehicle industry based on supply and demand, as of January 2012, the leading countries in the field of electric mobility are Japan, the United States, France, and Germany, followed by China, the United Kingdom, Italy, Denmark, South Korea, and Spain (Figure 4). In a report from Navigant Research (2015), worldwide sales of light duty electric vehicles are expected to increase from 2.7 million in 2014 to 6.4 million in 2023.

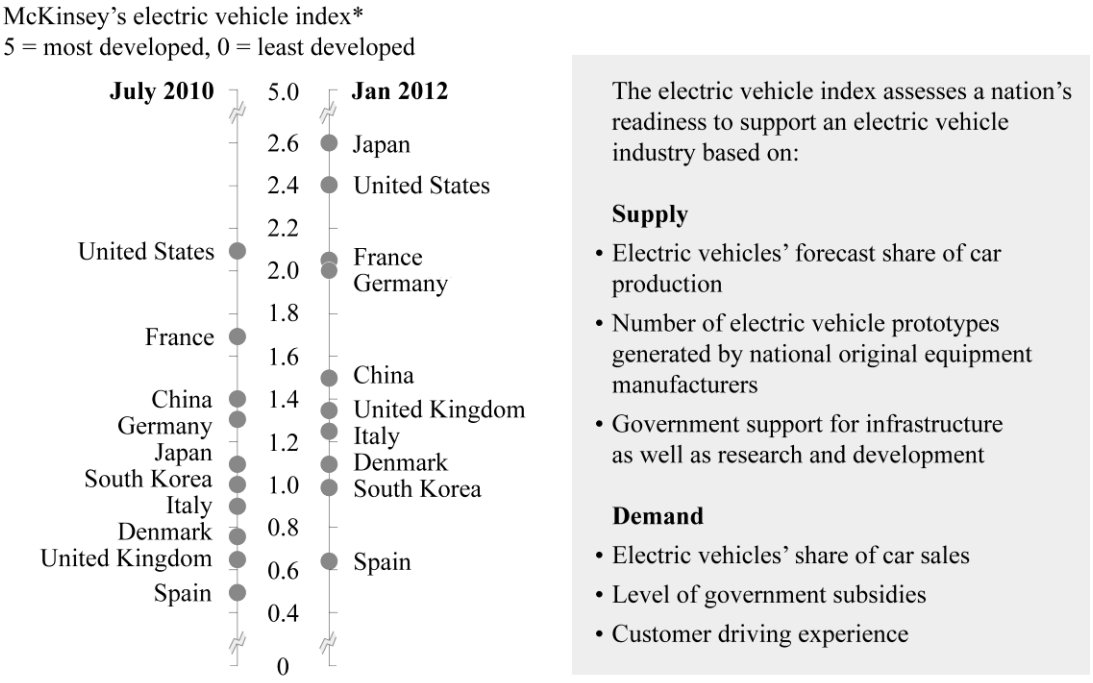

Figure 4. Leading countries according to McKinsey's electric vehicle index.
Source: Krieger, Radtke, & Wang (2012)

In the research field of electric carsharing, Green et al. (2014) argued that policies intending to establish electric vehicles in the market should not focus on mainstream consumers, but should instead focus on niche markets such as carsharing. Steininger and Bachner (2014) discussed an implementation of electric carsharing in Austria by a rail company to allow commuters access from their home to the nearest train station. Considering future trends of carsharing, Shaheen and Cohen (2013) conducted 25 interviews with carsharing experts worldwide and identified electric carsharing as a growing trend. Further studies in this concept compared cost and CO_2 savings between electric and conventional cars (Rabbitt & Ghosh, 2013) and investigated the attitude towards electric carsharing (Heling, Saphores, & Samuelsen, 2009; Hinkeldein et al., 2012).

2.6. *The Concept of Sustainability*

Carsharing is considered to have potential in helping to create a sustainable transportation system (Duncan, 2011). The concept of sustainability is regarded by many carsharing research articles, of which some put a stronger focus on environmental issues. For example, Firnkorn and Müller (2012) conducted a survey with carsharing members to examine environmental effects caused by the reduction of private car ownership. Further studies investigated the reduction of greenhouse gas (GHG) emissions through the implementation of carsharing services (Heling et al., 2009; Martin & Shaheen, 2011; Rabbitt & Ghosh, 2013). In particular, Martin and Shaheen (2011) examined the GHG emission impacts of carsharing in North America. They concluded that carsharing services are used by carless households with some increase in emissions and as an alternative with emission reductions, resulting in a net effect with an overall reduction in annual emissions.

3. Discussion and Practical Implications

In order to give implications for practice, ten critical success factors (CSFs) were identified from the literature. These ten CSFs are mentioned in six or more of the reviewed articles (Table 1). According to the literature, the CSFs contribute to the growth and success of carsharing services. We recommend carsharing providers to consider these CSFs in order to enhance the prospects of success.

Table 1. Critical success factors of carsharing services

	Critical success factors	**Sources**
CSF1	Population density	Andrew & Douma, 2006; Barrios & Godier, 2014; Barth & Shaheen, 2002; Catherine et al., 2008; Celsor & Millard-Ball, 2007; Correia & Antunes, 2012; Costain et al., 2012; Douma & Gaug, 2009; Engel-Yan & Passmore, 2013; Kent & Dowling, 2013; Litman, 2000; Rivasplata et al., 2013; Shaheen et al., 2002
CSF2	Shorter access distances to carsharing locations	Barrios & Godier, 2014; Fatmi & Habib, 2014; Kent & Dowling, 2013; Rickenberg et al., 2013; Shaheen & Cohen, 2007; Zheng et al., 2009; Zhou & Kockelman, 2011
CSF3	Lower rates of car ownership	Celsor & Millard-Ball, 2007; Coll et al., 2014; Engel-Yan & Passmore, 2013; Fatmi & Habib, 2014; Kent & Dowling, 2013; Millard-Ball et al., 2006; Morency et al., 2011; Nobis, 2006; Rivasplata et al., 2013; Stillwater et al., 2009; Zheng et al., 2009
CSF4	Areas with limited and expensive parking	Awasthi et al., 2007; Barrios & Godier, 2014; Celsor & Millard-Ball, 2007; Correia & Antunes, 2012; Engel-Yan & Passmore, 2013; Kent & Dowling, 2013; Martens et al., 2011; Millard-Ball et al., 2006; Rivasplata et al., 2013; Shaheen & Cohen, 2007; Shaheen et al., 1999
CSF5	Pedestrian and bike friendly areas	Andrew & Douma, 2006; Celsor & Millard-Ball, 2007; Douma & Gaug, 2009; Engel-Yan & Passmore, 2013; Kent & Dowling, 2013; Litman, 2000; Stillwater et al., 2009
CSF6	Transit accessible areas	Andrew & Douma, 2006; Awasthi et al., 2007; Barrios & Godier, 2014; Barth & Shaheen, 2002; Catherine et al., 2008; Celsor & Millard-Ball, 2007; Clavel et al., 2009; Douma & Gaug, 2009; Engel-Yan & Passmore, 2013; Heling et al., 2009; Huwer, 2004; Kent & Dowling, 2013; Litman, 2000; Martens et al., 2011; Rivasplata et al., 2013; Shaheen et al., 1999; Stillwater et al., 2009
CSF7	Mixed-use developments	Catherine et al., 2008; Celsor & Millard-Ball, 2007; Engel-Yan & Passmore, 2013; Fatmi & Habib, 2014; Kent & Dowling, 2013; Martens et al., 2011
CSF8	Cooperation with relevant stakeholders	Bardhi & Eckhardt, 2012; Catherine et al., 2008; Celsor & Millard-Ball, 2007; Clavel et al., 2009; Huwer, 2004; Loose et al., 2006; Shaheen et al., 2002
CSF9	Incentives to members	Dixit & Rashidi, 2014; Fellows & Pitfield, 2000; Rivasplata et al., 2013; Schaefers, 2013; Shaheen & Cohen, 2007; Zheng et al., 2009
CSF10	Implementation of information systems	Barth & Shaheen, 2002; Barth, Li, & Todd, 2004a; Clemente et al., 2013; Kek et al., 2006; Kent & Dowling, 2013; Khanna & Venters, 2013; Mannan, 2001; Shaheen et al. 1999, 2002; Shaheen et al., 2003, 2009

The first success factor refers to the **population density (CSF1)**, which offers various aspects to carsharing success. First, a higher population density implies more potential customers that is conducive to an increase in carsharing activities (Correia & Antunes, 2012; Costain et al., 2012). Second, denser areas result in **shorter access distances to carsharing locations (CSF2)**. This second factor contributes to the convenience of locations (Shaheen & Cohen, 2007), as carsharing services are considered much more successful if cars are located within walking distance around home and work locations (Fatmi & Habib, 2014; Kent & Dowling, 2013). Barrios and Godier (2014) mention 1/3 of a mile as an acceptable distance. A survey by Zhou and Kockelman (2011) shows that 30% of their

respondents are willing to walk more than a half mile to their reserved car, and less than half of the respondents are willing to spend more than five minutes on riding a bus to reach the carsharing location. Third, denser areas have **lower rates of car ownership (CSF3)**. A study by Celsor and Millard-Ball (2007) indicates that low car ownership has the strongest, most consistent correlation to the amount of carsharing services in a neighborhood. Furthermore, in **areas with limited and expensive parking (CSF4)**, car ownership is regarded as more costly and less convenient, making carsharing a more attractive option (Barrios & Godier, 2014; Celsor & Millard-Ball, 2007; Correia & Antunes, 2012).

Residents in **pedestrian and bike friendly areas (CSF5)** and **transit accessible areas (CSF6)** are also less likely to own a car, leading to a higher propensity to join a carsharing program (Celsor & Millard-Ball, 2007; Engel-Yan & Passmore, 2013). In a survey of 262 carsharing members, Lane (2005) found that 43% of the respondents walk, 36% take transit, and 21% bike to work; 61% own no car and 34% own one car. In view of transit accessibility, public transportation services can complement carsharing in terms of park and ride concepts, because transit users gain the flexibility to complete a commute to work or for other transit-based trips by using carsharing vehicles at transit stations like railway stations, bus stops, or airports (Andrew & Douma, 2006; Awasthi, Breuil, Chauhan, Parent, & Reveillere, 2007; Barrios & Godier, 2014; Celsor & Millard-Ball, 2007; Heling et al., 2009). Transit accessibility, high density, and parking pressures are phenomena particularly located in metropolitan cores, where mixed-use developments such as shopping malls are widespread (Awasthi et al., 2007; Kent & Dowling, 2013). Carsharing services located near **mixed-use developments (CSF7)** have a higher chance of success, because several studies confirm that carsharing trips are mainly made for shopping and leisure activities (Ciari, Schuessler, & Axhausen, 2013; Fatmi & Habib, 2014; Huwer, 2004; Leclerc, Trépanier, & Morency, 2013). Round-trip carsharing systems are considered to be suitable for shopping and leisure trips, while one-way and free-floating systems are more appropriate for trips like commuting to work – since working time does not translate into rental time (Ciari, Bock, & Balmer, 2014; Jorge et al., 2013).

Various papers refer to **cooperation with relevant stakeholders (CSF8)** as another critical success factor. Catherine et al. (2008) name the following partners, who are "critical to growing the program and can provide for a low-risk environment for the implementation of carsharing" (p. 10): Local government, transit agencies, businesses, universities, and developers. The local government can help through regulation, for example, through the provision of parking spaces or alterations to the planning code (Clavel et al., 2009), or through cost incentives such as taxes, fees, or prices (Bardhi & Eckhardt, 2012). In the context of governmental partnerships, a strong local champion of carsharing, for example a very influential political figure, can help to generate support and awareness for carsharing services (Catherine et al., 2008; Celsor & Millard-Ball, 2007). Transit agencies and businesses can also help to promote carsharing by providing incentives. For example, Swiss carsharing service Mobility cooperated with a transit agency in Zürich, giving transit users the opportunity to acquire combined tickets for price advantage reasons (Loose et al., 2006). Another example is the cooperation between Mobility and a retailer in Switzerland, offering a discount program for customers to collect bonus points for each carsharing rental (Loose et al., 2006). Once a certain number of bonus points were collected, the customers could make discounted purchases at the retailer. Cooperation with universities can help to advertise carsharing services to students and employees (Catherine et al., 2008). An example for a carsharing program for universities is "Zipcar for Universities", currently providing carsharing vehicles on over 100 campuses across North America. Developers and parking companies can support the expansion of carsharing programs, e.g., by providing dedicated parking spaces (Catherine et al., 2008).

Offering **incentives to members (CSF9)** plays an important role for the promotion of carsharing services, which is why carsharing providers should take this critical success factor into account. On the one hand, cost savings to members is regarded as a common driver of membership growth and

success (Dixit & Rashidi, 2014; Shaheen & Cohen, 2007). For example, Zheng et al. (2009) report that people who are concerned about the costs of car ownership are more likely to join a carsharing program. For this reason, the most established carsharing providers supply services including fuel, insurance, maintenance, parking, etc. in order to offer cost and time incentives to members. On the other hand, environmental pollution, which is described as a car ownership disadvantage (Shaheen & Martin, 2010), can be reduced by deploying carsharing vehicles (Rabbitt & Ghosh, 2013). Carsharing can result in an overall reduction of cars and less driving, leading to a decrease of environmental pollution (Martin & Shaheen, 2011). Furthermore, the deployment of electric vehicles in carsharing services can additionally reduce environmental pollution. However, motives directly related to personal benefits like cost and time savings appear to be more present than motives with an indirect influence on consumers like the reduction of environmental pollution (Schaefers, 2013). Another incentive that has become more and more important in recent years is the **implementation of information systems (CSF10)**. Barth et al. (2004a) already stated in 2004 that the implementation of information systems is a critical success factor in the growth of carsharing services. Several other studies emphasize the importance of information systems (Kek et al., 2006; Kent & Dowling, 2013; Khanna & Venters, 2013; Shaheen, Meyn, & Wipyewski, 2003; Shaheen et al., 2009), which make carsharing services more user-friendly (Barth et al., 2004a; Clemente et al., 2013). With regard to established carsharing providers, internet- and smartphone-based reservations, mobile applications, smart card access to cars, onboard GPS navigation, etc. are essential to the carsharing program's success.

4. Conclusions and Outlook

In this paper, a literature review on the topic of carsharing was presented, which is considered as a transportation alternative to private car ownership. In order to address the first research question, a conceptual structuring of the topic was created, identifying 130 articles and 6 concepts: market analysis, location, travel behavior, information systems, electric carsharing, and sustainability. With respect to the second research question, critical success factors of carsharing services were derived from the literature review and discussed for implications.

The literature review is subject to the following limitations, which present useful opportunities for further research. First, the search was limited to relevant literature published from 1999–2014. The literature review provides a holistic extract of carsharing literature in the particular period of time to give an overview of the current research and has no claim to constitute the research field of carsharing in its entirety. However, earlier publications could be regarded. Besides, we encourage researchers to conduct further literature reviews for the next years to come, since carsharing is a growing trend in practice as well as in research. Second, exclusively literature in the English language dealing with commercial carsharing was considered for the review. For example, regarding peer-to-peer carsharing, worldwide growth is predicted (Shaheen & Cohen, 2013). Hence, literature from other carsharing-related fields such as peer-to-peer carsharing, corporate carsharing, carpooling, ridesharing, bikesharing, etc. could be taken into account. Literature in other languages might be of interest, as well. Third, we encourage researchers to more deeply consider the identified literature of the respective concepts in order to discover research gaps. The concept matrix in Appendix 2 will help to determine the articles that correspond to the concepts in the appropriate field of research interest. Fourth, we call for a deeper examination of the critical success factors. Since the factors were derived from the literature, we recommend further research to analyze the world's leading carsharing providers such as Zipcar and car2go in the context of the implementation of the success factors in their carsharing services. A validation of the factors by means of empirical analysis such as expert interviews and user surveys would provide new findings. Furthermore, the investigation of critical

success factors specifically for electric carsharing would also give new insights for carsharing providers that offer or plan to offer electric vehicles for carsharing services.

As carsharing services became more successful over the last several years, the topic proliferated in research, as well. With regard to the concept development of carsharing research (Figure 2), we expect a further increase in importance of carsharing research in general and a growth of interdisciplinarity of the topic in the future.

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Appendix 1. Number of publications for journals and conferences

Journals	**1999-2002**	**2003-2006**	**2007-2010**	**2011-2014**	**Total**
Transportation Research Record	5	16	10	11	42
International Journal of Sustainable Transportation	0	0	1	6	7
International Journal of Automotive Technology and Management	0	0	0	4	4
Transport Policy	0	1	0	3	4
Transportation Research Part A: Policy and Practice	0	0	0	4	4
Transportation Research Part D: Transport and Environment	1	0	0	3	4
Ecological Economics	1	0	0	2	3
Transportation Research Part E: Logistics and Transportation Review	0	0	1	2	3
Computers & Industrial Engineering	0	0	0	2	2
Journal of Transport Geography	0	0	0	2	2
Accident Analysis and Prevention	0	0	0	1	1
Business Strategy and the Environment	0	0	0	1	1
Energy Policy	0	0	0	1	1
European Journal of Transport and Infrastructure Research	0	0	0	1	1
European Transport Research Review	0	0	0	1	1
IEEE Transactions on Intelligent Transportation Systems	0	0	0	1	1
Journal of Advanced Transportation	0	0	0	1	1
Journal of Consumer Research	0	0	0	1	1
Journal of Decision Systems	0	0	1	0	1
Journal of Public Transportation	0	0	0	1	1
Journal of the American Planning Association	0	0	0	1	1
Journal of the Urban Planning and Development	0	0	0	1	1
Service Business	0	0	0	1	1
Transport Reviews	0	1	0	0	1
Transportation	0	0	0	1	1
Transportation Research Part C: Emerging Technologies	0	0	0	1	1
	7	18	13	53	91
Conferences	**1999-2002**	**2003-2006**	**2007-2010**	**2011-2014**	**Total**
Annual Meeting of the Transportation Research Board	1	4	8	13	26
European Conference on Information Systems	0	0	0	2	2
IEEE Intelligent Vehicles Symposium	0	1	0	1	2
International Conference on Knowledge-Based and Intelligent Information and Engineering Systems	0	1	1	0	2
ACM Symposium on Parallelism in Algorithms and Architectures	0	0	0	1	1
IEEE Congress on Evolutionary Computation	0	0	1	0	1
IEEE International Conference on Systems, Man, and Cybernetics	1	0	0	0	1
International Conference on Application and Theory of Petri Nets and Concurrency	0	0	0	1	1
International Conference on Information Resources Management	0	0	0	1	1
International Conference on Information Systems	0	0	0	1	1
International Workshop on RFID Security and Privacy Issues	0	0	0	1	1
	2	6	10	21	39
Journals and conferences total	**9**	**24**	**23**	**74**	**130**

Appendix 2. Concept matrix of the literature review

Articles	Concepts					
	Market analysis	Location	Travel behavior	Information systems	Electric carsharing	Sustainability
Alfian et al., 2014		X				
Andrew & Douma, 2006	X					
Awasthi et al., 2007		X				
Bardhi & Eckhardt, 2012	X					
Barrios & Godier, 2014		X				
Barth & Shaheen, 2002	X					
Barth et al., 2003				X		
Barth et al., 2004a				X		
Barth et al., 2004b		X			X	
Barth et al., 2006	X					
Bieszczat & Schwieterman, 2012	X					
Briest & Raupach, 2011		X				
Burkhardt & Millard-Ball, 2006	X					
Catherine et al., 2008	X					
Celsor & Millard-Ball, 2007	X	X		X		
Cepolina & Farina, 2014		X			X	
Cervero, 2003	X					
Cervero & Tsai, 2004	X					
Cervero et al., 2007	X					
Chatterjee et al., 2013			X			
Chen & Regan, 2009				X		
Cheu et al., 2006		X				
Ciari et al., 2009	X					
Ciari et al., 2013	X	X				
Ciari et al., 2014		X				
Clavel et al., 2009	X					
Clemente et al., 2013		X			X	
Coll et al., 2014	X	X		X		
Concas et al., 2013		X	X	X		
Correia & Antunes, 2012		X				
Costain et al., 2012			X			
Dixit & Rashidi, 2014			X			
Douma & Gaug, 2009			X			
Duncan, 2011	X		X			
Efthymiou & Antoniou, 2014			X			
Efthymiou et al., 2013			X			
Engel-Yan & Passmore, 2013		X				
Fagnant & Kockelman, 2014		X	X			X
Fan, 2013		X				
Fan et al., 2008		X				
Fatmi & Habib, 2014			X			
Febbraro et al., 2012		X				
Fellows & Pitfield, 2000	X					
Firnkorn, 2012		X				
Firnkorn & Müller, 2011		X				X
Firnkorn & Müller, 2012	X					X
Fojcik & Proff, 2014			X		X	
Geum et al., 2014	X					
Grasset & Morency, 2010	X					

Green et al., 2014					X	
Habib et al., 2012			X			
Heling et al., 2009					X	X
Hinkeldein et al., 2012					X	
Huwer, 2004			X			
Jorge & Correia, 2013		X				
Jorge et al., 2013		X				
Karbassi & Barth, 2003				X		
Kasper et al., 2013				X		
Kato et al., 2012a	X		X			
Kato et al., 2012b	X					
Kek et al., 2006		X				
Kek et al., 2009		X		X		
Kent & Dowling, 2013	X					
Khanna & Venters, 2013				X	X	X
Kim & Yoon, 2012	X					
Klincevicius et al., 2014	X		X			
Kortum, 2014			X			
Lane, 2005	X					
Le Vine, 2014	X					
Le Vine et al., 2014a			X			
Le Vine et al., 2014b	X					
Leclerc et al., 2013			X	X		
Lee et al., 2011				X	X	
Lindloff et al., 2014			X			
Litman, 2000	X					
Loose et al., 2006	X					
Lorimier & El-Geneidy, 2013	X					
Mannan, 2001				X		
Marouf et al., 2014		X			X	
Martens et al., 2011	X					
Martin & Shaheen, 2011						X
Martin et al., 2010	X					
Millard-Ball et al., 2006		X				
Morency et al., 2008			X			
Morency et al., 2011			X			
Morency et al., 2012			X			
Mukai & Watanabe, 2005		X				
Musso et al., 2012	X					
Nobis, 2006	X		X			
Nourinejad & Roorda, 2014		X		X		
Ohta et al., 2013			X		X	
Prettenthaler & Steininger, 1999	X					
Rabbitt & Ghosh, 2013	X				X	X
Rhee et al., 2014		X	X	X		
Rickenberg et al., 2013		X		X		X
Rivasplata et al., 2013		X				
Rodier & Shaheen, 2004	X					
Ruhrort et al., 2014		X	X		X	
Schaefers, 2013			X			
Schmöller et al., 2014		X				
Schure et al., 2012		X				
Schuster et al., 2005	X					
Shaheen, 2000	X		X			

Shaheen, 2001	X				X	
Shaheen & Cohen, 2007	X					
Shaheen & Cohen, 2013	X				X	
Shaheen & Martin, 2010	X					
Shaheen & Novick, 2005	X					
Shaheen & Rodier, 2005	X					
Shaheen et al., 1999	X					
Shaheen et al., 2002	X				X	
Shaheen et al., 2003	X					
Shaheen et al., 2004	X					
Shaheen et al., 2006	X					
Shaheen et al., 2009	X					
Shaheen et al., 2010		X				
Shaheen et al., 2013	X				X	
Sioui et al., 2013			X			
Stasko et al., 2013		X	X			
Steininger & Bachner, 2014	X				X	X
Stillwater et al., 2009		X		X		
Tal, 2009			X			
Uesugi et al., 2007		X				
Wagner et al., 2014		X	X	X		
Wang et al., 2012	X					
Xu & Lim, 2007		X				
Zheng et al., 2009	X					
Zhou, 2013	X					
Zhou, 2014	X					
Zhou & Kockelman, 2011	X		X			
Articles per concept	**59**	**41**	**33**	**18**	**18**	**9**

Appendix 3. Overview of carsharing services

Headquarters	Carsharing service	Countries of operation	Website
North America			
Canada, Montreal	Communauto	Canada	communauto.com
Canada, Toronto	AutoShare	Canada	autoshare.com
Canada, Vancouver	Modo	Canada	modo.coop
Costa Rica, San José	SigoCar	Costa Rica	sigocar.com
Mexico, Durango City	Carrot	Mexico	carrot.mx
United States, Boston, MA	Zipcar (Avis Budget Group)	United States, Canada, United Kingdom, Spain, France, Austria	zipcar.com
United States, Clayton, MO	Enterprise CarShare	United States	enterprisecarshare.com
United States, Park Ridge, NJ	Hertz 24/7	United States, Canada, United Kingdom, Spain, France, Germany, Netherlands, Belgium, Australia	hertz247.com
United States, San Francisco, CA	City CarShare	United States	citycarshare.org
Europe			
France, Nice	Autobleue	France	auto-bleue.org
France, Paris	Autolib'	France	autolib.eu
France, Paris	Mobizen	France	mobizen.fr
Germany, Braunschweig	Quicar (Volkswagen)	Germany (Hannover)	quicar.de
Germany, Bremen	Cambio CarSharing	Germany, Belgium	cambio-carsharing.com
Germany, Cologne	Ford Carsharing	Germany	ford-carsharing.de
Germany, Cologne	Multicity (Citroën)	Germany (Berlin)	multicity-carsharing.de
Germany, Frankfurt am Main	Flinkster (Deutsche Bahn)	Germany, Netherlands, Austria, Switzerland	flinkster.de
Germany, Karlsruhe	Stadtmobil	Germany	stadtmobil.de
Germany, Munich	DriveNow (BMW)	Germany, United States	drive-now.com
Germany, Stuttgart	car2go (Daimler)	Germany, Austria, Denmark, Netherlands, Italy, United Kingdom, United States, Canada	car2go.com
Germany, Wiesbaden	book-n-drive	Germany	book-n-drive.de
Ireland, Dublin	GoCar	Ireland	gocar.ie
Netherlands, Rotterdam	Greenwheels	Netherlands, Germany	greenwheels.com
Sweden, Gothenburg	Sunfleet	Sweden	sunfleet.com
Switzerland, Lucerne	Mobility	Switzerland	mobility.ch
United Kingdom, Leeds	City Car Club	United Kingdom	citycarclub.co.uk
Asia			
China, Shanghai	eHi Fast Car	China	fastcar.1hai.cn
India, Bangalore	Zoom	India	zoomcar.in
Japan, Osaka	Orix CarShare	Japan	orix-carshare.com
Japan, Tokyo	careco	Japan	careco.jp
Japan, Tokyo	Times Car Plus	Japan	plus.timescar.jp
Singapore	CarClub	Singapore	carclub.com.sg
South Korea, Seoul	citycar	South Korea	citycar.co.kr
South Korea, Seoul	GreenCar	South Korea	greencar.co.kr
South Korea, Seoul	SoCar	South Korea	socar.kr
Australia			
Australia, Melbourne	Flexicar	Australia	flexicar.com.au
Australia, Melbourne	GreenShareCar	Australia	greensharecar.com.au
Australia, Sydney	GoGet CarShare	Australia	goget.com.au
New Zealand, Auckland	cityhop	New Zealand	cityhop.co.nz
South America			
Brazil, São Paulo	Zazcar	Brazil	zazcar.com.br

Note: In order to give an impression of the worldwide market of carsharing services, we created a list with 40 established carsharing providers from 5 continents, 19 countries, and 34 cities. We selected carsharing services according to the number of members and vehicles, as well as to the awareness and reputation by conducting a desk research. The intention of this table is to provide a selection of carsharing services, hence, a complete list would go beyond the scope at this point due to a large number of local carsharing services all over the world. Note that most providers offer electric cars in their programs and some providers (Autobleue and Autolib' in France, Multicity in Germany, and citycar in South Korea) offer exclusively electric cars.

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