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Carsharing: a systematic literature review and research agenda

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Received 3 October 2020
Revised 12 April 2021
26 June 2021
Accepted 28 June 2021

Abstract

Purpose – Following the recent surge in research on carsharing, the paper synthesizes this growing literature to provide a comprehensive understanding of the current state of research and to identify directions for future work. Specifically, this study details implications for service theory and practice.

Design/methodology/approach – Systematic selection and analysis of 279 papers from the existing literature, published between 1996 and 2020.

Findings – The literature review identified four key themes: business models, drivers and barriers, customer behavior, and vehicle balancing.

Practical implications – For managers, the study illuminates the importance of collaboration among stakeholders within the automotive sector for purposes of widening their customer base and maximizing utilization and profits. For policy makers, their important role in supporting carsharing take-off is highlighted with emphasis on balancing support rendered to different mobility services to promote mutual success.

Originality/value – This is the first systematic multi-disciplinary literature review of carsharing. It integrates insights from transportation, environmental, and business studies, identifying gaps in the existing research and specifically suggesting implications for service research.

Keywords Carsharing, Nonownership, Vehicle balancing, Automotive, Business model, Access-based consumption

Paper type Research paper

1. Introduction

Environmental concerns and the specter of "peak car" – the idea that per capita distance traveled by an automobile will now fall, threatening the traditional mass-market car business – have prompted automotive manufacturers, service providers, NGOs, and policy makers worldwide to devise and offer a wide range of carsharing services. Carsharing refers to the temporary right to exclusive use of a car without the responsibilities of ownership, with payments linked to usage and/or subscription fees. Unlike traditional car rental and leasing,

This research received financial support from the CarE-Service project (which received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 776851), and the SE:Kond 2 LIFE project (2019-04463), which was funded by Sweden's innovation agency Vinnova.

Journal of Service Management
Vol. 32 No. 6, 2021
pp. 55-91
Emerald Publishing Limited
1757-5818
DOI 10.1108/JOSM-10-2020-0344

carsharing relies on platform mediation to identify appropriate matches between provider resources and users and to facilitate exchange (Eckhardt *et al.*, 2019). While car rentals require a contractual agreement each time one rents a car, carsharing typically requires a membership and subscription. Lovelock and Gummesson (2004) suggested that such nonownership services – that is, marketing exchanges, which do not involve a transfer of ownership – differ distinctly from those that do, conveying benefits through temporary access rather than ownership. By securing the temporary right to use a good, customers avoid "the burdens of ownership" (Moeller and Wittkowski, 2010), such as responsibility for maintenance and repair. Although accumulated service fees over time may be higher than the purchase price, individual payments are lower, making nonownership more affordable by comparison (Schaefers *et al.*, 2018). Examples of carsharing include the pioneering Zipcar, which commenced operations in Massachusetts in 2000, and ShareNow, a collaboration between German automotive manufacturers BMW and Daimler. Achieving economic viability has proved challenging, and many projects are in retreat, for example, most of ShareNow's international operations have been closed down since 2019 (Miller, 2019). Nevertheless, industry and public research centers continue to invest heavily in new initiatives (Bocken *et al.*, 2020), and many carsharing service providers see long-term market potential. In 2019, the global carsharing market exceeded US$2.5 billion, with predicted growth of over 24% by 2026 (Global Growth Trends, 2021).

Mirroring these developments, research interest in carsharing has increased across diverse fields that include transportation, environmental and energy studies, and business and management. This research activity has yielded a wide array of analyses and is also an indicator that carsharing is seen to have wide-ranging implications for society. Research on carsharing also reflects the growing interest in various nonownership services (Schaefers *et al.*, 2016a; Fritze *et al.*, 2020). However, despite extensive attention from transportation and environmental researchers – as well as increasing popular interest and media coverage – few of these studies are grounded in service management research.

Against this backdrop, we conducted a systematic review to synthesize the growing literature on carsharing. The dramatic increase in publications in recent years highlights the need for such a review, with more than 60 scientific journal articles published in 2020 alone. The review had three aims: (1) to consolidate existing knowledge and to extract key insights across disciplines; (2) to identify implications for managers and policy makers; and (3) to outline an agenda for service research. The study addresses two main gaps in existing literature reviews. First, as most of these reviews focus on specific issues and fail to acknowledge the full array of relevant research themes, they are not directly comparable. Among these, Jorge and Correia's (2013) review focused specifically on vehicle relocation. Although Ferrero *et al.*'s (2018) review was (we believe) the first attempt to comprehend the existing carsharing literature, it was not systematic, and their search covered only papers on access-based carsharing published during the period 2001–2016. As more than 180 papers on carsharing have since been published, an updated review is needed to capture newer and more relevant insights on subjects such as peer-to-peer (P2P) carsharing. Furthermore, Ferrero *et al.*'s study focuses on transportation-related outlets and issues, so neglecting important service management and marketing-related issues. On that basis, the present study addresses the need for an exhaustive thematic review.

The rest of the paper is structured as follows: Section 2 describes the methodology for the systematic selection and analysis of relevant publications. Section 3 presents the study findings, which are grouped under four themes: business models, drivers and barriers, customer behavior, and vehicle balancing. Section 4 outlines a carsharing research agenda that addresses key questions and challenges for service providers and customers. In conclusion, Section 5 identifies some key implications for managers and policy makers.

2. Methodology

The growing volume of fragmented research across disciplines makes it challenging to keep up with existing knowledge of carsharing, and a systematic literature review is needed to integrate findings and perspectives while minimizing bias (Snyder, 2019). A systematic review is an effective means of critically evaluating a body of literature in an objective, transparent, unbiased, and rigorous way (Boell and Cecez-Kecmanovic, 2015; Lyngdoh *et al.*, 2021) and increases the validity of the review process (Palmatier *et al.*, 2018). Following Tranfield *et al.* (2003), our approach involved three stages: planning, conducting and reporting the review.

2.1 Planning and conducting the review

In the first stage (*planning*), we assessed the need for a systematic review of the carsharing literature. In the second stage (*conducting* the review), we identified and selected relevant publications, using the specified keywords ("carsharing," "shared mobility," "mobility services" and "mobility-as-a-service") to search the Scopus database. As a leading database, Scopus is widely used for systematic reviews (e.g. Raddats *et al.*, 2019; Witell *et al.*, 2016). To ensure that the search was comprehensive, we used the Boolean operators "AND" and "OR" (Cronin *et al.*, 2008). As keywords are the cornerstone of a systematic literature review (Timmins and McCabe, 2005), we selected terms that were contextually relevant and reflected the scope of the carsharing literature, excluding related but distinct terms like "ride sharing" or "ride hailing." Although terms like "shared mobility" and "mobility-as-a-service" tend to be broader in scope than carsharing, some such studies nevertheless relate to carsharing and are likely to provide relevant insights (e.g. Cohen and Kietzmann, 2014). More generic terms like "sharing economy" or "access-based services" were not included because a majority of these studies only refer to carsharing as an example among many other services rather than as the focal concern (e.g. Eckhardt *et al.*, 2019; Fritze *et al.*, 2020). Studies that discuss carsharing in detail, like Bardhi and Eckhardt (2012), appear in searches using the term "carsharing," but we deliberately excluded studies dealing with other nonownership services that do not involve shared car use, such as car leasing (e.g. Wittkowski *et al.*, 2013).

The search covered peer-reviewed journal papers published in English up to the end of 2020. To ensure a comprehensive overview of the field, the search was not confined to particular subjects or journals (Snyder *et al.*, 2016), yielding an initial total of 1,417 papers. To begin the exclusion process, we read the abstracts and eliminated 1,051 papers that we deemed to be beyond the scope of our review. Some of the excluded papers related to topics like carbon emissions, autonomous vehicles, electric vehicle ownership, ride hailing, and ride sharing. Some addressed topics like mobile networks or mobility aids for the visually impaired but did not focus on automotive mobility, and these were also eliminated at this stage, leaving 366 papers in total. In the second round of the review, we read the remaining papers in full to assess their quality and to extract relevant information. We excluded any publications whose content failed to meet the specified criteria, for example, shared mobility studies with a very limited discussion of carsharing, or papers that focused on other vehicle sharing systems like bike sharing. As a result, a further 87 papers were excluded, leaving a final sample of 279 papers (see Appendix for subject areas, journals by subject, and number of papers published in each journal). Figure 1 summarizes the search and selection process.

To begin the review stage, the lead author read and categorized each paper in relation to the research topic. The research team then discussed the results, paying particular attention to papers in which the dominant theme was less easily discerned. For example, although electric vehicle carsharing was originally identified as a distinct theme, it was subsequently assimilated to other themes because it was the focus of interest in only a limited number of papers. This iterative analysis yielded four major themes: (1) the wide variety of carsharing

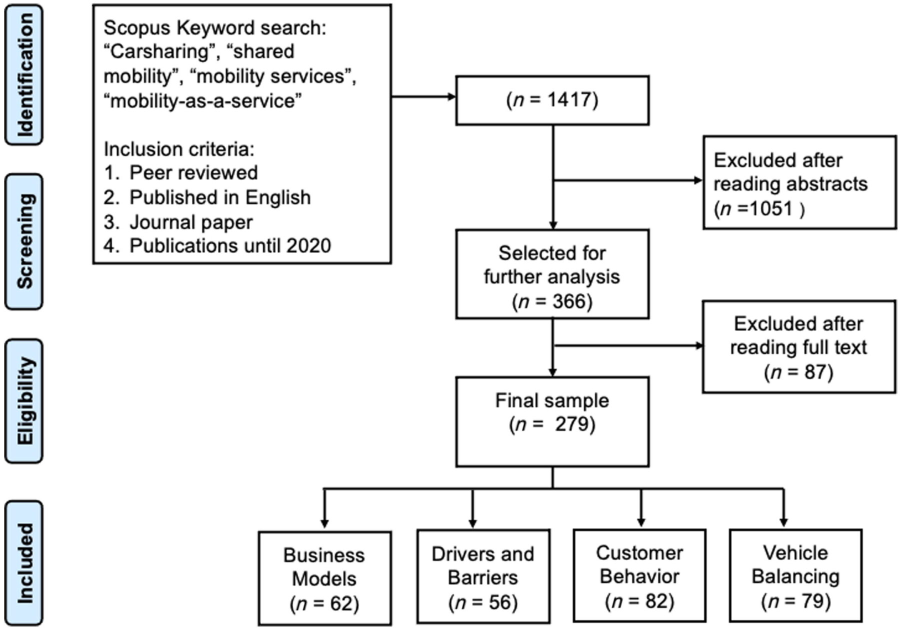

Figure 1.
Literature search and selection process

business models (n = 62); (2) customer and service provider drivers and barriers (n = 56); (3) usage characteristics of carsharing customers, including behaviors and motives (n = 82); and (4) vehicle balancing, encompassing issues related to station location and vehicle relocation (n = 79). To assess the reliability of this categorization, another researcher independently reviewed the final sample of 279 papers. We assessed inter-judge reliability in terms of the proportional reduction in loss, which at 0.96 was well above the recommended 0.90 threshold for advanced practice (Rust and Cooil, 1994). In cases where the two researchers differed – usually where a paper covered more than one theme – the research team jointly reviewed and discussed the study before agreeing a mutually acceptable categorization. Any additional relevant insights beyond a study's core theme are noted in the results.

2.2 Descriptive analysis of the field

Research on carsharing has grown rapidly, and the number of papers published in the last four years was more than double the total for all previous years combined. On average, less than two papers were published annually between 1996 (when the first paper appeared) and 2011. The topic began to attract greater research interest in 2012, when 15 papers were published, almost equaling the number of papers published in all previous years combined. Since then, the topic has attracted increasing research attention, and more than 60 papers were published in 2020 alone. Research initially focused on the nature of existing and potential business models for carsharing, customer reasons for engagement and customer behavior; over the years, interest has extended to key challenges like vehicle balancing. Table 1 shows the evolution of coverage of the four themes.

Overall, research on carsharing has most often appeared in transportation journals (125/279), with fewer (43/279) in business and management publications (including service and marketing) or environmental and energy journals (58/279) (see Appendix). However, the three most cited papers for each theme appear in business and management journals (four papers), transportation journals (six papers), and environmental and energy journals (two papers) (see

Table 1. Publications by topic and year

Theme	1996	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Business models	2	1				1									5	2	1	7	2	10	8	10	13
Drivers and barriers			1	1					1		1		1	1	1	1	2		3	11	4	16	12
Customer behavior	1	1												1	8	4	3	7	9	9	5	14	20
Vehicle balancing										1	1	1		1	1	2	5	7	3	6	14	16	21
Total	3	2	1	1		1			1	1	2	1	1	3	15	9	11	21	17	36	31	56	66

Table 2.
Most cited papers by theme

Theme	Authors	Journal	Focus	Method	Citations
Business models	Bardhi and Eckhardt (2012)	Journal of consumer research	Access-based consumption	Interviews $n = 40$	883
	Möhlmann (2015)	Journal of consumer behavior	Collaborative consumption	Two surveys ($n = 236, 187$)	563
	Cohen and Kietzmann (2014)	Organization and environment	Shared mobility business models	Conceptual	424
Drivers and barriers	Shaheen and Cohen (2012)	International journal of sustainable transportation	Station-based carsharing	Three surveys: $n = 33, 22, 25$	308
	Prieto *et al.* (2017)	Transportation research part A: Policy and practice	Impact of sociodemographic variables on carsharing	Survey $n = 2{,}733$	87
	Wilhelms *et al.* (2017a)	Technological forecasting and social change	P2P carsharing	Interviews $n = 20$	59
User behavior	Dijk *et al.* (2013)	Energy policy	EV mobility	Conceptual	178
	Efthymiou *et al.* (2013)	Transport policy	Adoption of vehicle sharing systems	Survey $n = 233$	152
	Schaefers (2013)	Transportation research part A: Policy and practice	Consumer cognitive processes	Interviews $n = 14$	132
Vehicle balancing	Kek *et al.* (2009)	Transportation research part E: Logistics and transportation review	Optimal parameters for vehicle relocation	Simulation modeling	227
	Correia and Antunes (2012)	Transportation research part E: Logistics and transportation review	Station location in one-way carsharing	Mixed-integer programming	201
	Boyaci *et al.* (2015)	European journal of operational research	Vehicle relocation in one-way EV sharing	Location modeling	196

Source(s): Scopus, June 2021

Table 2). While citation analysis is biased toward older publications, it is a useful way of identifying the main work in a given field (Raddats *et al.*, 2019; Zupic and Čater, 2015). It is interesting that while the majority of papers were published in transportation journals, the two most cited papers were consumer studies that appeared in business and management publications. It is also notable that despite the growing importance for service and marketing researchers of concepts like the sharing economy and collaborative consumption (e.g. Eckhardt *et al.*, 2019; Guyader, 2018), few such studies have specifically investigated carsharing. As discussed below, it therefore seems useful to develop a fuller account of user needs and the challenges faced by carsharing service providers from the perspective of service management.

3. Results

This section discusses the four themes elaborated in the third review stage (reporting and dissemination) (Tranfield *et al.*, 2003). To begin, the evolution of carsharing is briefly summarized.

3.1 Evolution of carsharing

The concept of carsharing can be traced back to 1948 in Zurich, Switzerland, when the earliest known carsharing cooperative was formed by a group of private individuals. This initiative was followed soon after by similar ventures in other European countries, including France and the Netherlands (Shaheen *et al.*, 1998). Early carsharing schemes operated on a round-trip basis, in which the customer returned the car to its original pick-up location at the end of each rent period. The earliest known one-way carsharing scheme (known as Procotip) was established in France in 1971, but it failed as a result of technological issues and a lack of appropriate control systems (Shaheen *et al.*, 2015). Despite these early efforts, successful cases of carsharing were not identified until the late 1980 and 1990s, when various carsharing cooperatives in Switzerland (e.g. Mobility) were established. In 2008, Daimler formed the first free-floating carsharing scheme (then called Car2go and now known as ShareNow) in Ulm, Germany (Firnkorn and Müller, 2012).

As concern grew about traffic congestion caused by increased car ownership (Steininger *et al.*, 1996), carsharing was seen to offer multiple benefits to users, governments and service providers (Tuan Seik, 2000). Beyond its initial appeal to environmentalists and community activists, today's users are motivated by factors like personal convenience and cost savings (Orski, 2001). Other reported reasons for adopting carsharing include time savings, traffic mitigation, and individual attitudes (Fellows and Pitfield, 2000). Shaheen *et al.* (1999) predicted that carsharing providers might combine their operational expertise with other advanced technology suppliers to offer mobility services with social, economic and environmental benefits. In many respects, this is true of carsharing today, which has been transformed by advances such as P2P services and technologies, growing stakeholder cooperation and integration, new automotive ventures, and a renewed emphasis on electric vehicles (EVs).

3.2 Carsharing business models

A business model describes how a business creates and captures value, articulating the value proposition, resources, and associated costs and revenue mechanisms (Teece, 2010). Among carsharing services providers, business models vary widely from access-based services such as business-to-consumer (B2C) and business-to-business (B2B) models and cooperatives to platform-based peer-to-peer (P2P) models.

Most carsharing business models fall into the category of access-based services (Bardhi and Eckhardt, 2012), which allow customers to access a product for a specified period in return for an access payment while the service provider retains legal ownership (Schaefers *et al.*, 2016b). Access-based services are considered suitable for convenience-seeking customers who do not care about the value of ownership and favor monetary savings (Hazée *et al.*, 2017). According to Hazée *et al.* (2017), such services entail a high level of customer involvement, minimal supervision by the service provider and high levels of interpersonal anonymity, as customers have minimal contact with other customers or employees when accessing the products.

3.2.1 Business-to-consumer carsharing. As the most common type of carsharing, B2C models have so far received the most research attention. This form of carsharing entails ownership of a fleet of cars by a firm, which rents them on demand to private individuals for short periods of time (Münzel *et al.*, 2018). In addition to these independent service providers, car manufacturers also engage in B2C carsharing in their search for new markets (Bellos *et al.*, 2017; Perboli *et al.*, 2018). As the owner (or lessee), the service provider assumes responsibility for car maintenance and marketing transactions (Wilhelms *et al.*, 2017a). B2C carsharing is generally usage-based, that is, members pay a service provider for access to cars at a given rate based on minutes or hours, or at a daily rate for distance traveled (Schmöller *et al.*, 2015). Different membership types are often available – for example, pay-per-use or monthly subscription – according to the customer's expected level of usage (Bocken *et al.*, 2020). B2C carsharing may be one-way or round-trip (in which the car is returned to the pick-up location after use) (Cohen and Kietzmann, 2014; Le Vine *et al.*, 2014). Additionally, membership may be station-based or free-floating; in the former case, the customer must leave the car at a *designated* station within a given area, while a free-floating arrangement means they can leave the car at *any* location within the designated area (Shaheen *et al.*, 2015). Users of free-floating and station-based services typically use the cars for short trips while round-trip customers mostly take longer trips (Alencar *et al.*, 2019). Use of free-floating or station-based carsharing also varies according to trip length and purpose (Heilig *et al.*, 2018); while station-based carsharing is favored mainly when a car is the most effective solution, the free-floating option is often preferred for nonregular trips (Becker *et al.*, 2018) and saves time as compared to alternatives like public transport (Becker *et al.*, 2017a). Examples of B2C carsharing include Zipcar (founded in 2000 and acquired by Avis Budget Group in 2013) and ShareNow, a joint venture involving the German manufacturers BMW and Daimler.

3.2.2 Business-to-business carsharing. B2B carsharing – also referred to as corporate carsharing or employer-based carsharing (Clark *et al.*, 2015) – is an option for organizations that do not wish to own or lease a fleet. Using this form of carsharing, employers provide access through a service provider to shared cars for employees' work-related trips (Fleury *et al.*, 2017). B2B carsharing customers may be private or public sector organizations (Clark *et al.*, 2015). B2B carsharing is usually offered by B2C service providers (e.g. ShareNow and Volvo Car's M), and the two models are broadly similar, aside from the fact that the B2B customers are organizations, and subscriptions or payments are made by the organization rather than the individual user. Typically, an employer signs a contract with the provider that specifies fees and terms of payment for the service. Potential customer benefits include lower travel costs as compared to car rental or taxis, as well as flexible fleet size, customized services and price models, and consolidated invoicing. For larger customers especially, service providers must have the necessary resources to provide personal support (e.g. through key account managers) and to ensure that the value potential is realized. Although one study of carsharing behavior in Toronto reported that B2B customers use carsharing more frequently than B2C customers (Costain *et al.*, 2012), B2B carsharing has so far received much less research attention.

3.2.3 Cooperative carsharing. A third type of access-based carsharing business model is also known as the nonprofit car club (Bonsall *et al.*, 2002) or self-regulating community (Hofmann *et al.*, 2017), based on collective car ownership and usage within a defined or institutionalized local group such as friends, neighbors or a nonprofit organization (Nitschke, 2020). This model is typically characterized by a communal interest in sharing cars rather than any profit motive (Cohen and Kietzmann, 2014; Münzel *et al.*, 2018). Members of cooperative carsharing schemes usually pay an annual membership deposit or monthly mileage fees, with contractual obligations governing car maintenance and other administrative responsibilities (Bocken *et al.*, 2020). As nonprofit organizations, cooperative carsharing schemes can often secure funding from government agencies and foundations. As they are usually community-based, these schemes tend to be small in size, favor a round-trip approach and offer only limited choices of car. One example of cooperative carsharing is the member-owned Modo, which was founded in 1997 in Vancouver, Canada.

3.2.4 Peer-to-peer carsharing. P2P carsharing business models can be classified under the broader term *collaborative consumption*, which is defined as the use of online marketplaces and social networking technologies to facilitate peer-to-peer resource sharing (Barnes and Mattsson, 2016; Hamari *et al.*, 2016). P2P carsharing involves a triadic relationship between a car owner, a platform provider and a car renter (the customer) (Wilhelms *et al.*, 2017a). For the car owner, this involves renting out one's personal car and collecting the agreed monetary compensation (Barbour *et al.*, 2020); for the customer, it entails renting a car from a private individual through an online platform (Meelen *et al.*, 2019). As the platform provider does not own any cars, its role in P2P carsharing is to act as an intermediary between the car owner and customer (Meelen *et al.*, 2019; Münzel *et al.*, 2018). P2P carsharing customers often pay a fee per use, and the platform provider takes a percentage of the rental fee paid by the customer. Under the P2P arrangement, the car owner assumes responsibility for maintaining and cleaning the car (Hartl *et al.*, 2018) and determines the rental duration (Bocken *et al.*, 2020). As P2P platform providers do not incur fleet investment costs, this form of carsharing has higher scalability potential than the access-based model (Hampshire and Gaites, 2011; Meelen *et al.*, 2019).

While sharing of goods between individuals has always existed, the idea of P2P carsharing as a business is quite a recent development. Despite its growing popularity, this model has not received much research attention to date, and most studies focus on customer motivations (e.g. Barbour *et al.*, 2020; Dill *et al.*, 2019; Wilhelms *et al.*, 2017b). Examples of P2P carsharing platforms include Getaround, which operates in the US and in some European markets (including France and the UK) and Turo, which operates in the US, Canada and the UK.

3.2.5 Business model typology. Based on the work of Hahn *et al.* (2020) and Wilhelms *et al.* (2017b), Table 3 outlines the main characteristics of each business model. There are several differences between carsharing business models beyond value proposition, resources and revenue mechanism. Pricing is one of the most important factors, as it plays a role in determining the customer type and level of usage (Balac *et al.*, 2017). Various strategies have been devised to make carsharing profitable, including dynamic pricing schemes based on availability and time (Giorgione *et al.*, 2020); for a company targeting a younger clientele, for example, the ideal pricing model combines usage-based and monthly fees (Hahn *et al.*, 2020). In the early phase of P2P carsharing, there were several experiments in the absence of an established pricing model; for instance, some operators allowed car owners to specify their own rental prices while others allowed the platform provider to set the price (Barbour *et al.*, 2020).

Both P2P and cooperative carsharing have a cost advantage over B2C and B2B. As cooperative schemes are not profit-driven, and P2P car owners usually only want to earn some additional income from their cars, rental prices are usually lower than those of B2C and B2B providers, who need to make a profit on their investment (Hofmann *et al.*, 2017; Münzel *et al.*, 2018). A second difference relates to fleet size; while cooperative schemes often have only a few cars, B2C and B2B providers range from hundreds to more than a thousand cars (depending on the city size), or indeed several thousand in the case of P2P (Münzel *et al.*, 2018). In terms of required investment, this means that both B2B and B2C carsharing providers need significantly more capital than cooperative or P2P schemes. Additionally, as P2P cars are owned by individuals, the level of service provided may vary from one individual car owner to another.

3.2.6 Digital technologies. Digital technologies have had a major impact on the development of carsharing business models, especially P2P. Lagadic *et al.* (2019) observed that while carsharing is not a new service type, it has been completely transformed by advances in digital technologies. Although access-based services derive from traditional marketplace rental models, they have evolved through digital technology into a more collaborative and self-service approach (Bardhi and Eckhardt, 2012). Similarly, the growth of carsharing has been aided by advances such as mobile apps, global positioning system (GPS), software that monitors fuel and battery usage, open-ended booking and smart locks that allow instant access (Alfian *et al.*, 2015; Münzel *et al.*, 2018). In B2B carsharing setups, online dashboards can offer customers a consolidated overview of all user activities.

While technology plays an integral role in all types of carsharing, P2P carsharing relies more than other business models on technological innovations (Julsrud and Farstad, 2020). In particular, P2P carsharing must make booking and key exchange as convenient as possible (Sprei and Ginnebaugh, 2018), and this has become easier with smart locks that allow renters to access a car without having to meet the owner (Münzel *et al.*, 2018). The increased

Business model	Access-based models B2C	B2B	Cooperative	Platform-based models P2P
Examples	Zipcar, ShareNow	ShareNow, Volvo car mobility (M)	Modo	Getaround, Turo
Value proposition	Provides individuals with access to a new car without the burdens of ownership	Provides organizations with access to cars for work-related trips without the burdens of fleet ownership; offers consolidation of fleet management activities	Provides communities with access to cars without the burdens of individual ownership	Provides individuals with access to privately owned cars at lower prices than alternative traditional B2C carsharing. Participating car owners can defray some of the ownership costs and monetize an idle asset
Key resources	Car fleet, fleet management, service network, usage and user behavior data	Car fleet, fleet management, service network, account management, contracting, usage and user behavior data	Car fleet, members' network	IT platform, insurance and assistance coverage, car owner, usage, and user behavior data, wide variety of cars in the network
Revenue mechanism	Monthly subscription or pay-per-use	Contract-based	Annual membership or monthly fee	Pay-per-use
Market mediation	Commercial	Commercial	Not-for-profit	Commercial
Car ownership	Carsharing company	Carsharing company	Joint ownership by members	Private individuals
Investment requirement by the provider	High	High	Moderate	Low
Pick-up and drop-off mode	One-way or round-trip	One-way or round-trip	Round-trip	Round-trip
Involved actors	Carsharing company, customers	Carsharing company, employer organization and employees	Cooperative association, car renters	Car owners, platform providers, customers
Business model innovator	Carsharing company	Carsharing company	Cooperative members	Platform provider
Fleet variety	Low–medium	Low–medium	Low	High
Geographical coverage	Limited to busy areas	Limited to busy areas	Selected geographical areas (often neighborhood scale)	Wide coverage
Car maintenance and cleaning	Carsharing company	Carsharing company	Contractual obligations	Private car owner

Source(s): Adapted from Wilhelms *et al.* (2017) and Hahn *et al.* (2020)

Table 3.
Carsharing business models

incorporation of technology into carsharing services enhances the value proposition for the customer by making the service more flexible and convenient (Lagadic *et al.*, 2019). As noted above, from a service research perspective, P2P carsharing differs from other carsharing models by virtue of its triadic structure. While many of the factors discussed here are relevant to all business models, most studies of carsharing explicitly or implicitly refer to B2C models or to access-based models in general. For that reason, it is important to highlight the differences between B2C and P2P models, especially with regard to customer behavior drivers and barriers.

3.3 Drivers and barriers

Individuals and business customers increasingly choose to rent objects for specific periods of time as needed rather than owning them; Lovelock and Gummesson (2004) refer to this as the rental/access paradigm. This is explained by Moeller and Wittkowski (2010) in terms of what they refer to as *the burdens of ownership*; that is, product ownership entails certain burdens that users may prefer to avoid, such as risks related to product updates and obsolescence, responsibility for product maintenance and repair, and incurring the full cost of the product. In the same way, carsharing customers are driven by a desire to avoid the burdens of car ownership. Carsharing has multiple benefits as an affordable mobility alternative for lower-income groups like students and seniors, and as a substitute for transport alternatives such as walking and biking (Cohen *et al.*, 2008). Most studies of the decision to use carsharing relate to B2C business models, and some recent studies have specifically discussed the issue in the context of B2B or communal carsharing, but few studies to date have dealt specifically with drivers and barriers in relation to P2P carsharing.

3.3.1 Key factors driving the demand and use of carsharing. Multiple studies have found that propensity to adopt carsharing in general is commonly influenced by sociodemographic, geographic and socioeconomic factors (e.g. Cartenì *et al.*, 2016; Coll *et al.*, 2014; Kang *et al.*, 2016). Other factors include convenience (Orski, 2001; Peterson and Simkins, 2019), mobility patterns, family decisions, cost, and quality of alternative transport modes, lifestyle, and customer segment (Chun *et al.*, 2019; Hahn *et al.*, 2020).

Sociodemographic factors like age and gender are often mentioned as influencing factors for adoption of carsharing (e.g. Carteni *et al.*, 2016; Juschten *et al.*, 2019; Shaheen and Martin, 2010). Some studies report that the average carsharing customer is young, male, middle class, more highly educated and from a household of below-average size (e.g. Becker *et al.*, 2017a; Clewlow, 2016; De Luca and Di Pace, 2015; Hjorteset and Böcker, 2020; Tyndall, 2017). In a web-based study of vehicle availability in ten different European cities, Boldrini *et al.* (2019) found a positive correlation between carsharing demand and sociodemographic and urban indicators such as high educational attainment. In a survey of women's carsharing usage, del Mar Alonso-Almeida (2019) attributed the predominance of male carsharing customers to the fact that the mobile technology platforms on which carsharing services are based are less appealing to women than to men. Similarly, the predominance of younger carsharing customers can be attributed to their greater familiarity with technological devices like smartphones (Burlando *et al.*, 2019; Guglielmetti Mugion *et al.*, 2019).

Geographically, carsharing demand is higher in urban centers than in rural areas (Prieto *et al.*, 2017); this can be attributed to factors that make car ownership difficult and more expensive in urban centers, such as limited parking space. Carsharing adoption is positively affected by availability of other transport modes and scarcity of parking space (Csonka and Csiszar, 2016: Juschten *et al.*, 2019; Münzel *et al.*, 2020). In addition, close proximity to a carsharing station or to available cars increases the probability that individuals will use carsharing (Diana and Ceccato, 2019; Jian *et al.*, 2016; Juschten *et al.*, 2019; Kent *et al.*, 2017; Zhou and Kockelman, 2011). A survey in Beijing by Shaheen and Martin (2010) established that one kilometer is the maximum distance that users are willing to walk to a carsharing station.

Regarding socioeconomic factors, the claim that carsharing is valued for its ability to provide cost savings for customers (Duncan, 2011; Orski, 2001) is contradicted by Hjorteset and Böcker (2020). In their investigation of propensity to adopt carsharing in Norway, they showed that carsharing appeals mainly to individuals who are unconcerned about reducing their expenditure, indicating that the choice is not motivated by cost reduction. Similarly, in a study of carsharing in Switzerland, Juschten *et al.* (2019) reported that high income increases the probability of adopting carsharing. However, Hjorteset and Böcker (2020) did not distinguish between P2P and B2C customers, and results may vary by carsharing type. While carsharing in the developed economies of Europe and North America is used predominantly by highly educated individuals (Boldrini *et al.*, 2019; Clewlow, 2016; Coll *et al.*, 2014; Hjorteset and Böcker, 2020; Münzel *et al.*, 2020), Chun *et al.* (2019) reported that the opposite is true for developing economies, where highly educated individuals are more likely to favor car ownership.

Studies of the drivers of carsharing indicate a clear relationship between carsharing and urban population density (e.g. de Lorimier and El-Geneidy, 2013; Cohen *et al.*, 2008; Coll *et al.*, 2014; Csonka and Csiszar, 2016). For example, Becker *et al.* (2017b) found that free-floating carsharing in Switzerland scales with population density and social activity in a given area. As it is also more prevalent in areas with low car ownership and public transport, they concluded that carsharing serves as an alternative to these transport modes. Similarly, in their analysis of factors that favor carsharing, Coll *et al.* (2014) identified urban sprawl and a fairly good public transport system as drivers of carsharing.

Carsharing is often linked to general environmental benefits such as reduction of greenhouse gas emissions (Cohen *et al.*, 2008; Fleury *et al.*, 2017). According to a study investigating choice of transport mode under uncertainty (Kim *et al.*, 2017a), improving the symbolic value of carsharing as an environmentally friendly solution by use of EVs makes it a more attractive option and increases market share. Carsharing is perceived as more environmentally friendly than private car ownership (Münzel *et al.*, 2020) but less environmentally friendly than public transport (Kim *et al.*, 2017a). However, in a study of EV carsharing in Germany, Schwabe (2020) found that customer adoption of carsharing depends on more than perceived environmental friendliness. A study based on in-depth interviews with carsharing users in Norway (Julsrud and Farstad, 2020) reported similar findings in relation to cooperative carsharing, revealing that in addition to environmental benefits, customers chose cooperative carsharing for its practical benefits, such as the convenience of access to a car. In short, as with carsharing in general, environmental consciousness may be one key driver but is insufficient alone.

Factors affecting demand may also depend on the type of carsharing. For example, if B2B corporate customers are to adopt carsharing, providers must meet high expectations in terms of flexibility and service quality (Loose *et al.*, 2006). Fleury *et al.*'s (2017) survey of intention to use B2B carsharing in France indicates that motivating factors – especially for first time users – include tutorial videos, training and ease of access to the service provider. Probability of adoption is further increased if the service provided is perceived as environmentally friendly, which resonates with the growing emphasis on embedding sustainability goals in corporate strategies.

While most existing studies focus on access-based services (especially B2C), the factors that affect demand for P2P carsharing may differ for access-based carsharing models. In a study of five European cities, Münzel *et al.* (2020) reported that, in contrast to B2C, demand for P2P carsharing was not affected by population density. For car owners and service providers, the greater scalability of P2P overcomes the geographic limitations of B2C carsharing as it is not dependent on population density (Dill *et al.*, 2019).

3.3.2 Key barriers to carsharing demand and use. The success of carsharing depends on making it more attractive to potential customers by overcoming perceived barriers (Kim *et al.*, 2017b). While previous research focused on the burden of ownership (e.g. Moeller and Wittkowski, 2010), Hazée *et al.* (2017) and Valor (2020) discuss the burdens of access and sharing, respectively. Hazée *et al.* (2017) classified the burdens of access in terms of functional and psychological barriers. Functional barriers included service complexity, which is associated with perceived access, usage, and understanding, and reliability, which refers to uncertainty about product performance and related technology. Psychological barriers included perceived contamination, referring to the fact that the product is also accessed and used by other (unknown) individuals, and responsibility, referring to customer concerns about being held accountable for their own and others' usage of available services.

These barriers also affect carsharing. In an early study, Shaheen *et al.* (1998) identified the limited availability of cars as one factor that limited the use of carsharing in residential areas. This finding relates to the issues of complexity and reliability identified by Hazée *et al.* (2017) as difficulty in accessing carsharing services when required undermines reliability and so acts as a barrier to adoption and use. Using a two-phase online survey, Kim *et al.* (2017a) confirmed that likelihood of carsharing use diminishes as waiting time increases. In the case of access-based services, cars must therefore be strategically located to service a wider pool of customers (Kim *et al.*, 2019). In their study of Communauto in Montreal, Canada, de Lorimier and El-Geneidy's (2013) multilevel regression analysis showed that an efficient carsharing system must constantly attract new customers to compensate for lower use among seasoned members. To ensure customer satisfaction, the ideal situation combines high car availability and high car usage.

Low public awareness was identified by Zhou *et al.* (2017) as another significant obstacle to carsharing adoption in their survey of projected carsharing in Australia, Indonesia, Malaysia and Thailand. This problem relates to the compatibility barrier, where unfamiliarity can be a limiting factor. For example, lack of prior experience of similar services (such as car rental) is likely to deter certain potential customer groups from using carsharing. Both Duan *et al.* (2020), who used a stated preference survey to quantify the impacts of potential carsharing demands in Shanghai, and Zhang and Li (2020), who tested a model based on the theory of planned behavior in a study involving university students in Qingdao, China, reported that individuals who are familiar with car rental programs are more inclined to use carsharing.

In addition, nonmonetary costs (such as the inconvenience of having to reserve a car each time it is needed) may act as a barrier to carsharing (Duncan, 2011). In a survey to understand the factors that influence carsharing adoption, Burlando *et al.* (2019) found that issues like comfort and independence, which are often associated with private car ownership, may discourage carsharing adoption. Table 4 summarizes the main customer drivers and barriers identified in the literature.

3.3.3 Drivers and barriers for service providers and car owners. While much of the research on carsharing drivers and barriers has focused on the customer (especially in relation to B2C carsharing), only a handful of studies have discussed the service provider perspective. Service providers offer carsharing services for different reasons. Among profit-driven ventures, pure B2C and B2B service providers are motivated mainly by the desire to make a profit on their services, while car manufacturers offer carsharing services mainly to expand their market and to explore untapped niches (Bellos *et al.*, 2017; Perboli *et al.*, 2018). On the other hand, in a study of 235 car owners in Portland, Oregon, who rented out their cars for P2P carsharing, Dill *et al.* (2019) found that they were motivated by the prospect of generating extra income, low levels of car use and willingness to help others. Even if not in financial need, car owners in P2P carsharing schemes may be motivated by a desire to maximize car

Factors	Key studies	Key points
Drivers		
Sociodemographic	Becker *et al.* (2017a), Burlando *et al.* (2019), Cartenì *et al.* (2016), De Luca and Di Pace (2015), Guglielmetti Mugion *et al.* (2019), Hjorteset and Böcker (2020), Prieto *et al.* (2017), Shaheen and Martin (2010), Tran *et al.* (2019), Tyndall (2017)	Higher demand among single-person households, especially males in their 20s and 30s and city center residents Customers are predominantly young, male, middle class, more highly educated and from a household of below-average size
Geographic	Csonka and Csiszar (2016), Diana and Ceccato (2019), Jian *et al.* (2016), Juschten *et al.* (2019), Kent *et al.* (2017), Kim *et al.* (2017b), Münzel *et al.* (2020), Zhou and Kockelman (2011)	Customers who opt for carsharing are encouraged by car availability, reliability and parking conditions
Socioeconomic	Boldrini *et al.* (2019), Hjorteset and Böcker (2020), Clewlow (2016), Coll *et al.* (2014), Chun *et al.* (2019), Münzel *et al.* (2020)	Higher education levels, moderate upper income levels
Population density	Becker *et al.* (2017b), Cohen *et al.* (2008), Coll *et al.* (2014), de Lorimier and El-Geneidy (2013)	Carsharing scales with population density and social activity in a given area
Environmental benefits	Kim *et al.* (2017a), Münzel *et al.* (2020), Julsrud and Farstad (2020)	Environmental benefits are important but are not the sole driver of carsharing service use
High service quality	Fleury *et al.* (2017)	Customers, especially B2B, are attracted by high-quality services such as fleet management, tutorials and ability to access help
Barriers		
Limited availability	Shaheen *et al.* (1998), Kim *et al.* (2017a), Kim *et al.* (2019), de Lorimier and El-Geneidy (2013)	Likelihood of using carsharing services is reduced by increased waiting time for a shared car
Low public awareness	Burlando *et al.* (2019), Duncan (2011), Zhang and Li (2020), Zhou *et al.* (2017)	Customers that have not previously used carsharing or similar services such as car renting are less likely to join a carsharing scheme
Burdens of sharing	Valor (2020)	Customers and car owners in P2P carsharing experience burdens related to sharing, especially insecurity and uncertainty regarding contractual conditions

Table 4.
Key customer drivers and barriers identified in the literature

utilization or to make use of an otherwise underutilized asset (Ballús-Armet *et al.*, 2014; Barbour *et al.*, 2020; Dill *et al.*, 2019). The claim that public awareness drives engagement in carsharing is further supported by the evidence that car owners who are familiar with the concept are more likely to offer their cars for P2P carsharing than those who are not (Münzel *et al.*, 2019).

In addition to the high levels of investment required to engage in B2C and B2B carsharing, operational hurdles such as vehicle balancing (especially in one-way schemes, as discussed in detail in section 3.5) present serious challenges for service providers. While many of the barriers that affect platform-based services have also been identified in studies of access-based services, P2P carsharing must overcome some specific additional hurdles. P2P platform providers often face the double challenge of attracting both car owners and customers (Wilhelms *et al.*, 2017b). Based on 20 in-depth interviews with early adopters in Spain, Valor (2020) identified burdens for car owners that included emotional costs associated with the difficulties of sharing, the possibility of damage and perceived physical insecurity when driving the returned car. For customers, burdens included anticipated friction with owners, uncertainty about contractual conditions, limited reliability and availability, and perceived insecurity when driving a P2P-rented car.

Access-related barriers for P2P car owners include the perceived risk of limited access to their car (Hazée *et al.*, 2020) and possible damage to the car while rented out. In a study of P2P carsharing in California, Ballús *et al.* (2014) noted that where the platform provider's package did not include insurance, fewer owners were willing to offer their car, as they would incur higher costs in the event of it being damaged. Hazée *et al.* (2020) discuss the image barrier as a common feature of collaborative consumption. As users are required to evaluate each other, car owners who worry that P2P carsharing may affect their standing in subsequent service requests may decide to withdraw.

3.4 Customer behavior

This theme relates to the travel behavior of carsharing customers, including specific customer traits and how they use carsharing services.

3.4.1 Usage characteristics of carsharing customers. Depending on the type of customer, carsharing services are used in different ways. In the case of B2C services, private individuals typically use carsharing for leisure travel and shopping (Sioui *et al.*, 2012), while organizations use B2B carsharing for employees' work-related trips (Clark *et al.*, 2015). In terms of demand, it may prove worthwhile to attract both private individuals and organizations as two customer groups that complement each other because they use cars at different times. In other words, private individuals might use the service for evening and weekend errands and leisure activities (Costain *et al.*, 2012; de Lorimier and El-Geneidy, 2013), while organizations are likely to use the service during weekday working hours, so maximizing car utilization (Loose *et al.*, 2006).

Charoniti (2020) investigated stated preferences for carsharing under uncertain travel times and noted that use of carsharing is strongly dependent on activity type and context. For example, Wu *et al.*'s (2020a) analysis of carsharing in London indicates that infrequent customers often use carsharing to transport bulky luggage while frequent customers are typically commuters. According to Jian *et al.* (2017), while high-income customers who choose more luxurious brands use carsharing for leisure and business purposes, lower-income customers often use carsharing for special purposes like vans for moving or traveling with large groups of people.

Many individuals who register for carsharing schemes are not necessarily active customers and use the service only occasionally. In the case of Autolib, an early French EV carsharing initiative, frequency of use per customer continued to decline despite increasing membership; as many registered subscribers used the service infrequently, growth did not translate into increased revenues for the provider (Lagadic *et al.*, 2019). This issue is less significant for P2P car owners, who incur very low marginal costs in comparison to B2C providers, who own or lease large fleets (Meelen *et al.*, 2019).

For frequent users, carsharing is not their main mode of transport but is used in combination with other modes (Ruhrort *et al.*, 2014). Carsharing customers are more likely than car owners to use other complementary mobility services such as bike sharing, walking and public transport (Clewlow, 2016: Mishra *et al.*, 2015; Münzel *et al.*, 2019). For example, in comparisons of free-floating carsharing and public transport in Spain and Denmark, respectively, Ampudia-Renuncio *et al.* (2020) and Carrone *et al.* (2020) reported that free-floating carsharing is often used as a substitute for public transport. Becker *et al.*'s (2017a) comparative study of station-based and free-floating carsharing schemes in Switzerland reports similar findings.

Multiple studies have discussed the impact of carsharing on car ownership, and whether the need for a personal car is reduced by replacing it with a shared one (e.g. Firnkorn and Müller, 2015; Jochem *et al.*, 2020; Le Vine and Polak, 2019). While findings vary, some studies report evidence of a reduction in car ownership as a result of carsharing. For example, in a survey of B2C carsharing members in Seoul, South Korea, Ko *et al.* (2019) estimated that each shared car replaced 3.3 private cars. Similarly, a study of B2C carsharing providers in Germany found that car owners who adopted carsharing tended to use their own car less frequently (Loose *et al.*, 2006).

3.4.2 Trust. While trust is an important issue for all business models, its significance differs for B2C and P2P models. Several studies note the particular importance of trust for P2P carsharing; for example, in a study of German P2P providers, Wilhelms *et al.* (2017a) found that trust between car owners and customers was important, especially in relation to car usage behavior and maintenance. In their comparative study of B2C and P2P carsharing, Hartl *et al.* (2018) also found that because P2P carsharing involves transactions between strangers, the potentially higher economic risks and lack of regulation make trust more important. When offered a choice between B2C and P2P carsharing, customers tended to choose B2C because interacting with a company was perceived as less risky than with an individual. Similarly, Julsrud and Farstad (2020) reported that customers regarded B2C carsharing as (more) trustworthy and professional. According to Ma *et al.* (2020), trust can affect customer loyalty both directly and indirectly, prompting service providers to address this challenge by eliminating factors that might lead to loss of customer trust, such as high transaction costs. Table 5 summarizes the main reported usage characteristics of carsharing customers.

3.4.3 Customer misbehavior. As a form of service cocreation, the carsharing system involves customer interdependency in ensuring that the car is in good condition for the next customer (Bardhi and Eckhardt, 2012). Schaefers *et al.* (2016b) investigated misbehavior

Table 5. Main usage characteristics of carsharing customers

Usage characteristic	Key studies	Key points
Trip purpose	Clark *et al.* (2015), Costain *et al.* (2012), de Lorimier and El-Geneidy (2013), Loose *et al.* (2006), Sioui *et al.* (2012)	B2C: individual use for leisure trips B2B: work-related trips
Trip activity	Charoniti *et al.* (2020), Jian *et al.* (2017), Wu *et al.* (2020a)	A smaller car may suffice when commuting or traveling to a meeting; heavy-duty purposes (e.g. moving goods) may require a larger car
Frequency of use	Paundra *et al.* (2017), Münzel *et al.* (2019)	Carsharing customers are not necessarily frequent users; many use the service only occasionally
Multimodal mobility	Ampudia-Renuncio *et al.* (2020), Becker *et al.* (2017a), Carrone *et al.* (2020), Clewlow (2016), Mishra *et al.* (2015), Münzel *et al.* (2019)	Frequent travelers tend to combine use of carsharing with other modes of mobility such as walking and biking
Influence on car ownership	Firnkorn and Müller (2015), Jochem *et al.* (2020), Ko *et al.* (2019), Le Vine and Polak (2019), Loose *et al.* (2006)	Some studies report evidence of a reduction in car ownership as a result of engagement in carsharing
Trust	Hartl *et al.* (2018), Julsrud and Farstad (2020), Ma *et al.* (2020), Wilhelms *et al.* (2017a)	Trust is especially relevant for P2P carsharing because of the higher economic risks and the absence of regulation

among users of sharing services such as carsharing and identified a parallel with broken windows theory, in that one customer's misbehavior affects the next customer's behavior – in other words, misbehavior can be contagious. However, as the opposite is true in groups exhibiting high communal identification, it was considered more useful for service providers to strengthen their brand identity rather than investing in surveillance. Bardhi and Eckhardt (2012) conducted 40 interviews with Zipcar customers and found no sense of perceived ownership when using a car; in some cases, users preferred not to be associated with carsharing services. According to Schaefers *et al.* (2016b), the contagious effects of customer misbehavior suggest that deanonymizing service providers and customers may help to reduce misbehavior. In an experiment on motivating car inspection, Namazu *et al.* (2018) found that in the absence of a reminder, most customers did not inspect the car before use. Other undesirable behaviors such as late car return are more likely among P2P users than in B2C carsharing because customers may believe it is easier to discuss misbehavior with an individual than with a company (Namazu *et al.*, 2018).

3.5 Vehicle balancing

This aspect of one-way carsharing remains challenging for many providers of access-based services. In one-way carsharing, a short-term imbalance of cars often occurs at certain locations because of the uneven distribution of cars, that is, cars may be unavailable where they are needed while oversupplied at redundant locations. This is a likely consequence of flexible return times and locations, and the uneven flow of cars between stations means there may be too few cars at popular pick-up points (Nair and Miller-Hooks, 2011). The issue of vehicle imbalance is especially challenging for B2C providers as this business model most commonly offers one-way carsharing. The lack of adequate data makes it more difficult to resolve this problem (Ren *et al.*, 2020), and some studies have developed demand forecasting models to predict carsharing demand in pursuit of optimal business performance and customer satisfaction (e.g. Moein and Awasthi, 2020; Müller *et al.*, 2017). The next section discusses the challenge of selecting appropriate locations for carsharing stations and refers to studies that address the issue of vehicle relocation.

3.5.1 Station location. Appropriate station selection includes identification of lucrative locations (Cheng *et al.*, 2019) and ease of relocating cars between stations to meet demand (Boyaci *et al.*, 2015). In many cases, limited access means that some potential customers may be excluded, while those who can access the cars may not use them. Clark and Curl (2016), who studied UK bicycle and carsharing schemes, noted the importance of the station location in efforts to target potential and willing customers.

Hua *et al.* (2019) proposed an innovative framework for the deployment of one-way EV carsharing. They emphasized that identification of suitable stations is even more important for EV carsharing fleets because of issues such as battery charging and fluctuating travel time and demand. Seeking to identify optimal charging locations for one-way EV carsharing, Deza *et al.* (2020) showed how this can maximize balanced flow in carsharing networks. Given the uncertainty of travel demand, simulation models have been used to aid identification of optimal charging station locations for EV fleets (e.g. Brandstätter *et al.*, 2020; Kuwahara *et al.*, 2020; Lu *et al.*, 2020) and to assist fleet allocation (e.g. Deveci *et al.*, 2018). In their investigation of the factors that affect turnover at carsharing stations, Hu *et al.* (2018) found that in addition to spatial and temporal elements, station-level turnover and the relationship between transit and carsharing affect the use of shared cars. In identifying appropriate locations for carsharing stations, carsharing providers are encouraged to optimize efficiency, especially in densely populated areas, where cars occupy a significant amount of expensive parking space (Hu *et al.*, 2018). Sai *et al.* (2020) designed a model for EV carsharing and concluded that city population, proportion of available travel modes, station construction costs and budget should be considered when selecting station locations.

3.5.2 Vehicle relocation. Spatio-temporal imbalances in demand for one-way carsharing mean that cars must be constantly redistributed (Balac *et al.*, 2019), relocating them periodically between stations to ensure availability where they are most needed (Kim and Lee, 2017). Any imbalance in distribution makes carsharing less reliable (Balac *et al.*, 2019) and creates complexity barriers (cf. Hazeé *et al.*, 2017) for service providers, who must relocate cars to wherever they are required. Vehicle balancing efforts lead to various trade-offs; for example, Nourinejad and Roorda (2014) evaluated one-way carsharing performance by measuring effectiveness and proposed an optimization model for operational problems involving vehicle relocation. In the proposed model, increased fleet size means reduced time for relocation but also leads to increased costs. As another alternative, the same study proposed that fleet size could be reduced by extending reservation time to about 30 min. However, this might also result in reduced demand, as user privacy could be compromised in some instances by having to specify a return time window to facilitate vehicle relocation forecasting (Repoux *et al.*, 2019).

Over time, vehicle relocation models have been developed for operator-based, user-based and combined vehicle relocation. While operator-based models require staff members to move cars, user-based models rely on customers to do so (Brendel *et al.*, 2018). Testing the impact of vehicle relocation on competition among carsharing operators in Switzerland, Balac *et al.* (2019) found that to substantially affect demand, more employees are needed to perform the required relocations. Additionally, as cars are unavailable to customers while being relocated, no revenue is earned, making relocation less profitable (Balac *et al.*, 2019). These issues were further highlighted by Kypriadis *et al.* (2020), who noted that operator-based relocation requires multiple employees to ensure timely relocation. To minimize redundancy, it is also important to coordinate user-based and operator-based relocation (Brendel *et al.*, 2020a). This view is echoed by Huang *et al.* (2020), who note that user-based and operator-based relocation can be combined on the basis of pricing and the number of shifts, respectively, to correct any vehicle imbalance in one-way carsharing systems. In creating a decision support system for vehicle relocation, Kek *et al.* (2009) found that customers could be offered incentives in the form of reduced travel costs to encourage compliance with user-based relocation. Alternatively, this can be achieved by allowing customers to choose their own incentive, such as vehicle delivery, alternate pick-up location, alternate drop-off location or paid user relocation (Wu *et al.*, 2020b). Table 6 summarizes key findings related to vehicle relocation models.

Many existing vehicle balancing models are incremental improvements of earlier models. For example, Correia *et al.* (2014) discussed further options for customer pick-up and car drop-off, and Jorge *et al.* (2014) combined a mathematical model and a simulation model for optimal vehicle relocation and real-time relocation policy. Unlike simulation models that focus on one-way carsharing, Nourinejad and Roorda (2015) described a bi-modal scheme combining round-trip and one-way modes as one solution to the vehicle relocation problem in one-way carsharing services. Although convenient for customers, one-way services are costly for service providers because they require constant vehicle relocation. In contrast, round-trip systems are convenient for service providers because there is no vehicle relocation requirement, but this is less convenient for customers, who must return the car to its original pick-up point at the end of each trip (Jorge *et al.*, 2015). With the increasing popularity of EV carsharing fleets, more recent models take account of new requirements such as unplugging and recharging (e.g. Boyaci *et al.*, 2015; Weikl and Bogenberger, 2015). For example, based on two optimization models, Caggiani *et al.* (2020) proposed a shared (vehicle-to-grid) charging system that can help to minimize losses during charging times, so maximizing profits.

4. Discussion and research agenda

Despite the growing number of studies on carsharing, service scholars have shown surprisingly little interest to date, and there are ample opportunities for further research.

Relocation model	Key studies	Key points
User-based	Brendel *et al.* (2018), Brendel *et al.* (2020b), Kek *et al.* (2009)	(1) Cost efficient, as there are no customer-less trips (2) Price incentives can be used to encourage customers to engage in vehicle relocation (3) Less reliable, as customer compliance is not guaranteed
Operator-based	Bruglieri *et al.* (2014), Kek *et al.* (2009), Nourinejad *et al.* (2015), Repoux *et al.* (2019), Santos and de Almeida Correia (2019), Weikl and Bogenberger (2013)	(1) Relocation and maintenance can be combined (2) Reliable, as relocation is performed by staff (3) Costly, as customer-less trips are made (4) Requires service providers to account for staff relocation
Combination of user-based and operator-based	Brendel *et al.* (2020a), Huang *et al.* (2020), Wang *et al.* (2020)	(1) Coordination of user-based and operator-based models limits redundancy (2) Potential to reduce unnecessary waste of resources while improving vehicle circulation and utilization

Table 6.
User-based and operator-based relocation models

As our review indicates, transport and engineering studies predominate, advancing solutions to challenges like vehicle balancing. Based on our systematic review of the literature, we identified four themes as the basis for a service research agenda encompassing theory development and managerial practice. The proposed agenda addresses critical factors for the further growth of carsharing, including customer requirements, balancing supply and demand, and the effects of carsharing on car shedding. While ongoing experimentation continues to explore why certain provisions work better in some locations and markets than in others, a wide range of tools and methods is already available to address pressing issues such as the societal relevance of carsharing ventures and how best to ensure their success.

The research agenda addresses four key areas and associated questions, including key issues for managers and policymakers (see Table 7). While several of these topics are specific to carsharing services, we believe they also have broader ramifications for other mobility service issues, including multi-modal mobility and the rental/access paradigm in general (Lovelock and Gummesson, 2004). As our review illustrates, there is considerable heterogeneity in terms of business models and service systems across the various forms of mobility service. Even in the case of similar value propositions such as B2C and P2P carsharing, there are fundamental differences between their respective access-based and platform-based models and systems. Our findings also provide relevant insights and research directions for other forms of nonownership, shared use of other goods, or other types of short-term access to goods (e.g. bike sharing).

Carsharing is part of the wider shift from products to services commonly referred to as *servitization*. Although servitization research is among the most active domains in the field of service research and attracts interest from multiple disciplines, it has focused almost exclusively on B2B markets (Raddats *et al.*, 2019). In light of the rapid growth of servitization initiatives in consumer markets (e.g. subscription-as-a-service, sharing economy offerings), there is a need for a systematic overview and a roadmap for future research directions. In this context, it also seems timely to look at carsharing from a wider service management perspective as a market driven by technological and digital transformation.

Key research questions	Key managerial issues
Research area 1: critical factors for the growth of carsharing	
(1) What conditions are necessary for the growth of B2C carsharing?	(1) To identify possible solutions for B2C carsharing growth and to understand how these can be implemented
(2) What critical mass is required for the success of different types of carsharing service?	(2) To gain further insights into maximum car utilization
(3) How can insights from specific business models be harnessed to promote growth of other models and synergies between multiple models?	(3) To identify solutions that are accessible to a diverse range of customers
(4) How can service providers harness new technologies and usage data to drive innovation?	(4) To secure the competences needed to manage digital transformation and the "softwareization" of the industry
Research area 2: customer characteristics and requirements	
(1) How can customer and service provider goals be better aligned to devise balanced solutions for carsharing growth?	(1) To acquire knowledge relevant to the alignment of service provider and customer requirements
(2) What payment schemes are carsharing customers willing to accept?	(2) To promote interest in and acceptance of carsharing across diverse customer segments and markets
(3) What lessons can be learned from developing economies to promote the growth of carsharing?	(3) To identify alternative and unconventional solutions to existing carsharing challenges
Research area 3: addressing the imbalance between demand and supply	
(1) How can a balance be struck between fleet size and costs?	(1) To better understand the trade-offs in balancing costs and profits
(2) How can research on user-based relocation models help to solve the problem of vehicle balancing in one-way carsharing?	(2) To advance knowledge of user-based models and to validate their ability to solve vehicle balancing problems
(3) What are the unresolved challenges for existing vehicle relocation models?	(3) To enhance understanding and advance research on vehicle balancing strategies
Research area 4: understanding the effects of carsharing on car shedding	
(1) Under what conditions will carsharing encourage car shedding?	(1) To position carsharing schemes more effectively in contrast to car ownership
(2) What are the impacts of various carsharing modes on car ownership?	(2) To develop an understanding of service outcomes that can guide resource allocation
(3) How can advances in digital technology help to facilitate more seamless mobility experiences?	(3) To acquire and leverage customer data to align customer preferences and policy goals

Table 7. Research agenda and managerial implications

4.1 Critical factors for the growth of carsharing

Despite the evidence that some carsharing service providers are struggling, as seen in the closures across different markets, little of the existing research has sought to develop a better understanding of the key challenges. The present study identifies four main directions for future research. First, it will be important to identify the conditions necessary for the growth of carsharing. Carsharing is known to scale with population density and social activity – for example, in metropolitan cities (Clewlow, 2016) – and is also more prevalent in areas with lower car ownership and efficient public transport (Becker *et al.*, 2017b). However, a comparison of carsharing services and levels of substitution for other transport modes shows that carsharing usage levels remain low (Rotaris *et al.*, 2019). To address this issue, researchers should explore the factors impeding the progress of carsharing and how these can be managed.

Second, while studies point to high population density as a requirement for successful operation of carsharing, the required critical mass of users remains an unresearched issue. Studies of access-based carsharing have shown that most businesses need to achieve a critical mass to break even (Acheampong and Siiba, 2020; Lagadic *et al.*, 2019; Terama *et al.*, 2018). However, this is effectively a chicken-and-egg problem; while a critical mass of service users is required for scalability, users must be able to see scalability before being convinced to abandon their private cars in favor of carsharing. Furthermore, many members of carsharing schemes are not necessarily active customers, as many of those who register for these services use them only occasionally. As mentioned earlier, cost issues make this a more significant problem for B2C providers than for P2P owners and platform providers. Further research on the critical mass of users needed for different business models may enable service providers to solve the problem of maximum vehicle utilization.

Third, carsharing research should explore the different business models in greater depth to understand how they can be harnessed to promote carsharing, either as standalone models or in combination. As most research to date has focused on B2C carsharing, further research should place greater emphasis on P2P and B2B models. For example, as trust is an especially important issue for P2P carsharing, it would be useful to analyze how peer service providers can enhance profits by gaining their customers' trust (Benoit *et al.*, 2017). This in turn should contribute to the identification of underlying success factors that can be generalized to various forms of access-based carsharing. In practice, many commercial providers offer parallel B2C and B2B services and may have to do so to achieve the requisite utilization rate. Researchers should seek to determine how synergies between business models can best be managed and developed.

Finally, as technology plays an important role in the growth of carsharing, future research should explore how recent and imminent technological advances in the automotive sector can be harnessed to drive innovation and enhance the customer experience of carsharing. For example, some providers have incorporated EVs into carsharing fleets as a means of promoting sustainability and optimizing operational costs (Jacquillat and Zoepf, 2018). However, the challenges associated with EV fleets, including customers' inexperience and the need for a distinct service system, remain to be addressed. Advances in driving automation technology also afford opportunities to utilize customer data to provide better services for customers. Further research on these issues can help carsharing service providers to develop the competences they need to manage the industry's digital transformation.

4.2 Key customer requirements

Carsharing adoption has been attributed to the potential for exploiting the benefits of car ownership without bearing the costs (Shaheen *et al.*, 1998). At present, the known prerequisites include collaboration and transparency between stakeholders, demand synchronization, solutions for a diverse group of customers that are accessible and easy to use and adopt, the potential to combine mobility of people and goods, and public information about the availability of mobility services (Eckhardt *et al.*, 2019). However, service researchers have made only limited efforts to identify the key customer requirements for an optimal carsharing experience. On that basis, we can identify three key areas for future research.

First, while extensive research has focused on the customer, including customer behavior, drivers and barriers (especially in relation to access-based business models), few studies have addressed the motives of carsharing service providers. Different types of providers (e.g. pure service firms or automotive manufacturers) may have different reasons for venturing into carsharing, reflecting two broad and fundamentally distinct business models: car sales and leasing (which is managed primarily through third-party dealers) and carsharing. Future studies on service providers can also contribute to the development of balanced solutions based on better alignment of the service provider and customer requirements. Additionally, the perspective of car owners who rent their cars for P2P carsharing has been neglected by existing research (Hazée *et al.*, 2020).

A second direction for further research relates to payment schemes. To promote maximum car utilization and customer satisfaction, some studies (e.g. Le Vine *et al.*, 2014; Molnar and de Almeida Correia, 2019) have proposed the introduction of reservation systems to eliminate the current first-come-first-served approach. However, while such systems might seem to address the challenge of maximum utilization, they may have an opposite effect on long-term customer satisfaction, as customers are more willing to pay for a guaranteed reservation than for virtual queuing (Wu *et al.*, 2020a). The different types of carsharing providers have experimented with various pricing and payment schemes, such as pay-per-use or P2P's dynamic pricing based on time and usage. Lovelock and Gummesson (2004) proposed that pricing access-based services should relate to units of time but also noted that pricing schemes may need to be modified according to circumstance. Dowling *et al.*'s (2020) analysis of how users choose between different payment plans showed that carsharing customers typically opt for pay-per-use favor flexibility but tend to underestimate their usage. In general, further research is warranted on perceived utility and willingness to pay, as this may yield solutions to issues of scalability and stakeholder goal alignment.

A final area of concern is that much of the existing research has focused on developed countries in Europe, North America and Asia (including China) while neglecting developing economies with lower purchasing power parity. These less developed countries (in Africa, Asia and Latin America) account for the greater part of the world's population and stand for essentially all world population growth. Many of these markets are undergoing rapid urbanization but often lack efficient public transport and suffer from traffic congestion and poor air quality. As Lovelock and Gummesson (2004) noted, people in developing countries often find ways of improving their prospects through innovative sharing of goods and services. While such practices may not be directly replicable, mobility solutions in these markets may provide valuable insights for improving overall quality of life. Future research should seek to identify the key requirements for progressing carsharing in different customer groups and how these can be implemented in markets with service systems or institutional arrangements that differ fundamentally from high-income economies.

4.3 Addressing the balance between supply and demand

This problem occurs mainly in schemes that operate one-way carsharing although it is also relevant to the challenges of vehicle balancing management in general. To date, research in this area has been largely confined to the fields of computer science, engineering and mathematics, focusing mainly on simulation models to assist vehicle balancing. We contend that service researchers can address the imbalance between vehicle supply and demand in three areas.

First, it is clear from the various trade-offs associated with different approaches to vehicle balancing that there is no quick fix for this problem in the context of one-way carsharing. Specifically, service providers must choose between increased costs, reducing the time spent relocating vehicles and reduced customer demand. Service researchers should examine ways of striking a better balance between fleet size/mix and fixed and variable costs by incorporating factors such as customer preferences and behavior.

Second, while a number of studies have advanced user-based vehicle relocation models or a combination of user-based and operator-based models as cost-saving alternatives for vehicle balancing, there is some skepticism about customers' willingness to participate in vehicle relocation, regardless of incentives offered (Brendel *et al.*, 2020b). The question of whether user-based relocation models offer a viable solution remains unanswered in the absence of empirical studies to test these claims. Further research should therefore include empirical studies of user-based vehicle relocation as an alternative or a complement to operator-based relocation, as well as the range of customer motivations and their effects on engagement, usage and loyalty.

Finally, despite growing research interest and ongoing development of new relocation models, some issues remain unresolved. For example, as some relocation models are context-specific and refer to parameters for the city in question, generalizability is limited (e.g. Boyaci *et al.*, 2015; Di Febbraro *et al.*, 2018). Nevertheless, any lessons learned from these context-specific models should be disseminated to enhance general understanding and to inform further research on vehicle balancing strategies. Additionally, the interdependence of supply and demand is a crucial issue for the design of carsharing schemes but is often neglected in vehicle relocation models (Jian *et al.*, 2019). Finally, questions remain to be answered regarding the optimal inventory level at each carsharing station (Laporte *et al.*, 2018).

4.4 The effect of carsharing on car shedding

One matter of longstanding debate is whether carsharing might reduce traffic congestion by encouraging car shedding. Dowling and Simpson (2013) predicted that people's relationship with their cars would change, and that young people in particular would increasingly favor carsharing. This resonates with industry forecasts of a cultural shift in which the car ceases to be an object of ownership and instead becomes part of a service or a network of vehicles for collective use. However, in a study examining the effects of free-floating carsharing on the purchase of new vehicles in cities, Schmidt (2020) found that the claim that one shared car eliminates roughly three car purchases annually does not apply to high status cars such as SUVs or larger vehicles like vans. Similarly, Li and Kamargianni's (2020) research on how carsharing affects private car ownership and public transport demand established that people who take long trips are less likely to give up their private car in favor of carsharing. As one may reasonably assume that P2P sharing is also a less attractive option in such cases, the debate around carsharing as a means of reducing car traffic remains unresolved.

Further research on this topic should address three issues. First, the conditions under which carsharing might encourage car shedding remain unclear, and further research is needed. Ikezoe *et al.*'s (2020) survey of car owners in Japan found that car owners tend to have an emotional attachment to their cars and would only abandon them if carsharing tapped into factors beyond economic rationality (such as convenience). To position access-based and platform-based carsharing services as an attractive alternative to car ownership, researchers should explore the nature and impact of these underlying factors.

A second research direction relates to the fact that customer willingness to forego car purchases after joining a carsharing scheme may be contingent on carsharing type (Mishra *et al.*, 2015). For example, round-trip customers are more likely to abandon private ownership if they reduce that dependency by adopting other modes of mobility such as walking or biking. In contrast, one-way customers employ carsharing to replace modes such as taxi and ride hailing (Lempert *et al.*, 2019). Further research should therefore strive for a deeper understanding of how the various carsharing models impact car shedding. Such insights would help to develop an understanding of service outcomes that can guide resource allocation in carsharing schemes.

Finally, more research is needed to specify the ideal conditions for the co-existence of carsharing and other transport modes such as public transport and biking, both as separate services and for multimodal mobility. Contrary to popular belief, carsharing alone may not suffice to encourage car shedding but is more likely to succeed if combined with other transport modes. In fact, access-based carsharing is often most successful when combined with other complementary transport options (Csonka and Csiszár, 2016; Shaheen *et al.*, 1998). Future research should also explore how digital technology can be used to facilitate seamless multi-modal mobility services that align customer preferences and policy goals.

5. Conclusions and implications for practice

As evidenced by a growing number of publications over the last five years, carsharing has attracted significant attention from scholars, industry stakeholders and government organizations, reflecting ongoing challenges and the need for innovative mobility solutions. The aims of this literature review were to synthesize the extensive existing literature and to identify key areas for future research. Using a systematic approach, the review analyzed 279 studies published between 1996 and 2020, addressing issues that include existing business models, customer behavior, and user drivers and barriers, as well as the ongoing challenge of vehicle balancing. On that basis, we advanced a research agenda to address critical issues and to propose how existing challenges and opportunities can best be managed.

5.1 Managerial implications

The review identifies three main implications for carsharing service providers. First, managers need to understand the importance of building relationships with a wider range of stakeholders, especially when dealing with EV fleets. They must also understand the importance of customer and market factors; for example, while providers may be involved in the design of greenfield service systems from an early stage, initiatives in densely populated areas are different because parking space and charging infrastructure are scarce resources. Similarly, the requirements for P2P carsharing may differ significantly from B2C and B2B contexts. In every case, managers must understand customer needs, shape expectations and articulate potential benefits in terms of the appropriate service business model and ecosystem.

Second, managers must pursue innovations that will help to make carsharing attractive to the wider population; for example, Jian *et al.* (2020) suggested providing shared parking spaces for carsharing customers rather than simply providing carsharing services as is the current norm. This would enable carsharing service providers to make a profit by renting parking spaces from parking suppliers and then renting the same spaces to carsharing customers at a higher price. This would in turn deliver a higher utilization rate and a further increase in profits. Managers should also look to exploit ongoing technological advances to achieve synergies between business models, for instance, by leveraging customer data to reveal user patterns and so facilitate maximum utilization.

Finally, by targeting a broad base of customers through collaboration with other mobility providers (such as public transport), managers can identify key competences that can be utilized or synchronized to improve services. To that end, it will also be important to assess the potential market size in order to anticipate the impact of other mobility modes and to identify usage patterns that will optimize utilization rates and customer engagement.

5.2 Policy implications

For those making and implementing public policy, the present review has two main implications. First, given the potential of carsharing to resolve many pressing societal and environmental challenges such as traffic congestion and air pollution, such initiatives warrant the support of public and private stakeholders alike. However, policy interventions cannot simply support carsharing at the expense of public transport, nor can they enforce policies that simply make carsharing attractive to non-car owners; instead any such intervention must balance and direct provisions to maximize societal benefit. While service providers are often motivated by profit, regulatory bodies are driven by their duty to protect the interests of both users and providers (Lindloff *et al.*, 2014) and must therefore base supports on assessments of local need and the common good. Rather than undermining support for public transport and funding, policy can make carsharing a more attractive alternative to car ownership through a combination of rewards and penalties, for example, lower taxes on revenues from P2P carsharing in combination with more restricted or more expensive public parking. Policies should not simply aim to make carsharing more attractive, as this may prove counterproductive by attracting non-car owners who would otherwise use public transport.

Secondly, to improve traffic conditions and pollution, more support should be provided for EV carsharing fleets, engaging actively with challenges such as the provision of optimized charging stations. In their study of the optimal use of EVs in carsharing, Abouee-Mehrizi *et al.* (2021) identified three key factors: charging speed, charging station availability and battery range (in that order). Even if most carsharing users are not driving long distances, providers need to ensure that their fleets are charged – ideally, where they are parked. Automotive manufacturer Tesla owns and operates the largest global-charging network in the world (25,000+ Superchargers as of June 2021), but too much reliance on commercial actors may create brand-specific lock-in effects that inhibit growth and provision of the necessary infrastructure for local ventures. In short, public decision makers can play a more active role in facilitating the shift to electrification and shared mobility.

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Appendix

Research stream	No. of papers	Research stream	No. of papers
Transportation	*125*	*Environment and Energy*	*58*
Transportation Research Part D: Transport and Environment	18	Sustainability (Switzerland)	18
Transportation Research Part A: Policy and Practice	17	International Journal of Sustainable Transportation	15
Transport Policy	15	Journal of Cleaner Production	5
Transportation Research Part C: Emerging Technologies	13	Journal of Transport Geography	3
Transportation Research Part B: Methodological	13	Environmental Innovation and Societal Transitions	3
Transportation	13	International Journal of Environmental Research and Public Health	3
Journal of Advanced Transportation	7	Sustainable Cities and Society	2
Transportation Research Part E: Logistics and Transportation Review	5	Energy Research & Social Science	2
Transportation Letters	4	Energy Policy	1
Travel Behaviour and Society	4	Energy Efficiency	1
Transportation Science	3	Environmental Science and Policy	1
International Journal of Transport Economics	2	Habitat International	1
Transportation Quarterly	2	Resources	1
European Transport Research Review	2	Energy	1
Transport Reviews	1	Sustainability: Science, Practice and Policy	1
Traffic Engineering and Control	1		
Journal of Public Transportation	1	*Computer Science, Engineering and Mathematics*	*39*
Journal of Modern Transportation	1	IEEE Transactions on Intelligent Transportation Systems	4
European Transport–Trasporti Europei	1	Journal of Intelligent Transportation Systems: Technology, Planning, and Operations	2
European Journal of Transport and Infrastructure Research	1	Discrete Applied Mathematics	2
Advances in Transportation Studies	1	Electronics (Switzerland)	2
		Journal of Combinatorial Optimization	
Business and Management	*43*	IEEE Transactions on Systems, Man, and Cybernetics: Systems	2
International Journal of Automotive Technology and Management	4	Algorithms	1
Business Strategy and The Environment	4	Periodica Polytechnica Transportation Engineering	1
Manufacturing and Service Operations Management	3	Applied Sciences (Switzerland)	1
Research in Transportation Business and Management	3	IEEE Intelligent Transportation Systems Magazine	1
Technological Forecasting and Social Change	2	Discrete Optimization	1
European Journal of Operational Research	2	EPJ Data Science	1

(*continued*)

Table A1. Reviewed journals and research streams

Research stream	No. of papers	Research stream	No. of papers
Omega (United Kingdom)	2	Expert Systems with Applications	1
Business Horizons	1	IEEE Access	1
Cities	1	Transportation Research Record	1
Decision Support Systems	1	Information Systems	1
Computers and Operations Research	1	Information Systems and e-Business Management	1
EURO Journal on Transportation and Logistics	1	International Journal of Advanced Computer Science and Applications	1
Innovation	1	International Journal of Geographical Information Science	1
International Journal of Business and Globalisation	1	International Journal of Industrial Engineering: Theory Applications and Practice	1
International Journal of Information and Decision Sciences	1	Soft Computing	1
International Journal of Quality and Service Sciences	1	Journal of Intelligent and Fuzzy Systems	1
International Journal of Retail and Distribution Management	1	Journal of Simulation	1
Journal of Consumer Behaviour	1	Networks	1
Journal of Consumer Research	1	Networks and Spatial Economics	1
Journal of Ddecision Systems	1	Personal and Ubiquitous Computing	1
Journal of Science and Technology Policy Management	1	Pervasive and Mobile Computing	1
Journal of Service Research	1	Program	1
MIS Quarterly Executive	1	International Journal of Intelligent Transportation Systems Research	1
IEEE Transactions on Engineering Management	1	Transportation Research Interdisciplinary Perspectives	1
International Journal of Industrial Organization	1	Transportmetrica B	1
International Journal of Research in Marketing	1		
International Journal of Services and Operations Management	1	*Urban Studies and other social sciences*	*11*
Journal of Marketing Management	1	Transportation Research Part F: Traffic Psychology and Behaviour	3
Marketing Letters	1	Theoretical and Empirical Researches in Urban Management	2
Production and Operations Management	1	Journal of American Studies	1
		Urban Policy and Research	1
Economics	*3*	Continuum	1
Research in Transportation Economics	2	Journal of Environmental Psychology	1
Ecological Economics	1	Journal of Urban Planning and Development	1
		Planning Advisory Service Memo	1

Table A1.

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