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Innovations in Shared Mobility—Review of Scientific Works

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Abstract: Shared mobility is developing at a very fast pace around the world, becoming an alternative to classic forms of travel and, according to the public, providing innovative services. In recent years, these innovative services have also gained wide interest among scientists from a multicriteria point of view. However, among the topics and reviews in the literature, no review paper considering shared mobility in terms of innovation was identified. This article's research objective was to indicate the perception of innovation in shared mobility in scientific works. The results indicate that innovations in shared mobility are a niche topic considered in few scientific works. What is more, in most cases, shared mobility services are perceived as innovative in themselves without detailed service analysis. Moreover, the issues of open innovation, which are closely related to the concept of accessible Mobility as a Service system and smart cities, are often overlooked. In addition, there was no work identified that fully referred to all areas of innovative service. The article supports researchers in the determination of further research directions in the field of shared mobility and fills the research gap in the field of knowledge about open innovation, especially in the context of the development of shared mobility services in smart cities.

Keywords: shared mobility; innovations; open innovation; sustainable development; mobility management; smart cities; mobility in smart cities

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1. Introduction

In recent years, shared mobility services, that is, modern short-term vehicle rentals, have become widely available in modern cities on six continents of the world. The wide range of vehicles offered as part of their services, from bicycles to kick scooters, scooters, and cars, as well as the growing interest by authorities in promoting the implementation of services that offer an alternative to conventional mobility, or popularizing services in the name of sustainable development of vehicles, has led to a significant increase in the frequency of their use [1,2]. The indicated popularity was translated into numerical values, which demonstrate a development trend. Statistics show that revenue in the shared mobility segment is projected to reach USD 1.53 trillion in 2023, and that user penetration is 88.3% in 2023 and is expected to hit 92.8% by 2027 [3]. Along with the growing popularity of systems on their market, it was found that, within one city, there could be many service providers providing almost the same service and the same or similar vehicles. This kind of action has led to the phenomenon of growing competition around shared mobility service providers [4]. Growing competition, on the one hand, is a driver for change and, on the other hand, does not guarantee market success for each shared mobility operator on the market. As a result, it happens quite often that, despite grandly inaugurated systems, shared mobility operators are quickly temporarily or completely suspended, closed, and taken over. Then, many factors affecting the failure of the shared mobility market are provided, which include, among others:

- Unbalanced demand—a situation when the number of vehicles rented from a location may not equal the number of vehicles returned to this location [5];
- Unsuitable vehicle relocation [6,7];
- An improperly selected fleet of vehicles [8];
- An inappropriate business model [9];
- A closed approach to the willingness to share data, due to the lack of participation in mobility accelerators [10];
- Faulty system management without the indicated patterns [11–13];
- Improper management of the fleet of vehicles and their technical condition [14,15];
- Too high of a discrepancy between supply and demand [16,17].

In addition to the classic market problems of shared mobility, there were unexpected market circumstances related to the COVID-19 pandemic which directly affected the preferences of users of shared mobility systems [18], the durability and structuring of services provided during and after the pandemic [19], and the challenges facing the industry related to both the pandemic and the unexpected economic crisis [20]. To cope with market turmoil in the shared mobility industry, various types of innovations were introduced by the service providers. While various types of business practices in the industry are discussed, it is interesting how the scientific community relates to innovations in the shared mobility market. Are shared mobility innovations considered from a scientific point of view? Further, can these innovations be described as open innovations, i.e., those where an open and mutual approach to the process of creating and implementing or improving a given service is promoted [21]? An initial review of the literature did not identify any work that would constitute a review of work on innovation in shared mobility. To fill this research niche, our study was devoted to a review of the topic of innovations in shared mobility from the scientific works point of view. As part of the research, a synthesis of the literature was performed, which was confronted with business practices used in the shared mobility market. Our study is a compendium of knowledge on the perception of innovation in shared mobility research in the context of smart cities. It supports the determination of further research directions in the field of shared mobility. The article also fills the research gap in the field of knowledge on open innovation, especially in the context of the development of shared mobility services in smart cities.

2. Innovations—Basic Knowledge and Its Relation to Shared Mobility and Smart Cities

To understand the type of innovations present in shared mobility systems, it is necessary to define the basic issues related to shared mobility. Innovation is a sequence of activities leading to the creation of new or improved products, services, technological processes, or organizational systems. This term was introduced to economics by J. A. Schumpeter, thus indicating five cases of innovation [22]:

- Creation of a new product/service;
- Use of new technology or production methods;
- Creation of a new sales market;
- Acquisition of previously unknown raw materials;
- Reorganizations of a specific branch of the economy.

The typology of innovation is very complex. It includes, among others, the scope of innovations, their model, their extent, the scale of changes, the degree of originality and complexity of changes, the type of financing, and their attitude towards the environment or stakeholders involved [23].

Among the types of innovation, we can distinguish between closed and open innovation. Closed innovation is a term for the process by which organizations retain their ideas and knowledge within the organization, using them only to improve their own products and processes. This is the so-called traditional model, which assumes that the company retains control over its intellectual property and maintains a competitive advantage [24].

On the other hand, open innovation is the opposite of closed innovation. It is a term used to describe the process by which organizations allow external ideas and knowledge

to be used to improve their own products and processes [25]. This approach is based on collaboration with other companies, research institutions, and individual inventors. The goal is to create a network of resources that can generate new ideas and help them to market quickly [25]. The division of innovations is presented in Figure 1.

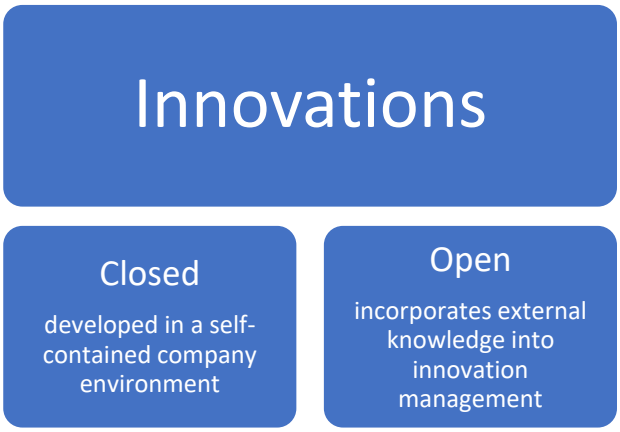

Figure 1. Types of innovations.

Open and closed innovations can also be distinguished from each other from the point of view of several basic factors such as the company's philosophy, approach to employees, capital, competition, or resources. A detailed comparison is presented in Table 1.

Table 1. Innovations comparison.

Feature	Closed Innovation	Open Innovation
The ideology of the company	Selection of innovations from the company's internal resources.	Conscious acquisition and export of knowledge to create, accelerate and improve innovation.
The role of customers	Passive recipients of the company's internal ideas.	Changemakers. Participants in the process of open exchange of ideas beyond the company's borders.
Venture capital	Slight importance.	Significant importance.
Competition	The desire to be the best on the market and the first when implementing a given innovation.	Developing a business model to improve products or services beyond being a market leader.

From the point of view of current cities, especially smart cities, innovations play a very important role. A smart city is an urban area that combines physical, social, and economic infrastructure with information technology to improve the collective intelligence [26] and the quality of services provided to citizens. Therefore, it is characterized by a high level of community commitment to making the city dynamic and economically efficient, socially stable, inclusive, attractive, and operationally sustainable [27]. This vision was largely inspired by the challenges the city faces in dealing with massive urbanization while maintaining the operation of essential services [27]. The challenges are related to the need for the city to connect institutional and industrial (economic, technological) stakeholders and citizens, while at the same time creating physical, social, economic, and technological infrastructure for innovation and improving services for citizens. There is also a need to ensure an understanding of smart cities as a data ecosystem where local governments coordinate data initiatives through three elements: openness, dissemination, and shared vision [28]. Therefore, a smart city can be defined as an ecosystem that allows innovative

initiatives driven by data and IT in an institutional context driven by the need to solve the urbanization problems faced by present and future cities [27]. Despite this uncertain context, there is no doubt about the multidimensional role of technology and innovation in urban areas and their impact on shaping the future of cities [29]. Although existing and emerging technologies offer great opportunities for cities to become "smarter", it is also clear that "technology is most effective when combined with institutional innovation and is not a substitute for improving governance, planning, operations and governance" [27]. Therefore, it is clear that information and information systems (IS) are at the heart of the challenges in smart cities, both as supporting infrastructure and as a digital innovation platform [27].

To properly navigate in smart cities, especially in urban congestion, one of the important factors is the possibility of moving. This aspect is closely related to one of the leading dimensions of modern and smart cities—smart mobility—which, next to smart economy, smart environment, smart people, smart living, and smart governance, is directly related to the fulfillment of the main social need, i.e., transport [30–34]. Smart mobility means using creativity or advanced technologies, including digital technologies, to manage transport and communication [31,32]. It refers to the use of modern technologies, including intelligent transport and environmental or energy technologies to ensure efficient movement [31,32]. Transport services that fit into the smart mobility concept are the so-called new mobility services, i.e., systems based on the ability to move freely using connected, shared, electric, and self-driving means of transport [33]. By definition, new mobility services, such as shared mobility, which are the subject of this work, should be related to innovations through the alternative that they provide. It is underlined that these services can benefit urban areas by improving accessibility, efficiency, removing transport barriers, reducing costs for users, improving the value of travel time, range, flexibility, safety, and overall integration of the transport system, and have the potential to contribute to the alleviation of transport inconveniences; therefore, it is important to develop these services [34]. In addition, it is indicated that innovations in new mobility are needed because they directly translate into physical and economic dimensions. Innovations redefine transport by creating holistic services that can meet the needs of consumers at their request, which is why their development is indicated as necessary for the proper development of transport technologies [34].

3. Research Methodology

To find out the level of scientific knowledge on innovations used in shared mobility systems, it was decided to review the literature. The task of the selected research method was to define the research query, indicate keywords, determine the database to which the search will be directed, indicate whether reviews of the literature fill the research gap of the query to which the article refers, determine what type of documents are in the database, define inclusion and exclusion criteria, perform a detailed analysis, synthesize documents, and indicate the results [35]. Among the various types of commonly available literature analyses, the method based on the systemic approach proposed by Booth et al. was selected [35]. Based on the selected methodology, the literature review was conducted as follows [35]:

- Indication of the research objective of the literature review.
- Performing a complete search, acquisition, and download of literature items.
- Extraction and evaluation of acquired literature items.
- Synthesis and detailed analysis of the results obtained.
- Presentation and sharing of results, comparison with business practices, and conclusions.

The first stage, following the adopted plan of conduct, was to define the research objective. The goal was to identify innovations in shared mobility systems. The scope of the study was defined through an extensive review of documents available on innovations in the publicly available scientific databases Scopus and the Web of Science. The choice of the databases was not accidental, because both databases are leaders in bibliographic information in today's academic world [36]. The Web of Science was chosen because it

provides a common search language, navigation environment, and data structure, allowing researchers to search broadly across disparate resources and use citation connections to navigate to relevant research results [37]. In turn, the Scopus database was selected because it is one of the largest curated abstract and citation databases, with a wide global and regional coverage of scientific journals, conference proceedings, and books, which ensuring that only the highest quality data are indexed through rigorous content selection [38].

Boolean functions, which enable a thorough logical analysis ensuring the sense and truthfulness of the statements sought during literature reviews, were used to search for individual publications in the indicated databases [39]. The research period covered March 2023. In the first stage, the term "shared mobility" was searched in the titles, abstracts, and keywords contained in both analyzed databases. The focus was on works written in English. The author's name was excluded from the search to avoid citing her research. The detailed search formula was as follows (1):

$$OS = DOC_{TIT\ ABS\ KEY} = (shared\ mobility) = 22,147\ documents \quad (1)$$

where *OS* refers to overall search and $DOC_{TIT\ ABS\ KEY}$ refers to documents that included the "shared mobility" phrase in their titles, abstracts, and keywords.

The first general search identified 22,147 documents in the form of articles, monographs, books, and conference papers that contained the term "shared mobility" in the title, abstract, or keywords. The number of searches turned out to be so high because the term "shared mobility" is used with many different meanings and in various scientific disciplines not necessarily directly related to real mobility. In the next step, among the works on shared mobility, those devoted to innovations were searched. The detailed search formula was as follows (2):

$$\begin{aligned} DS = DOC_{TIT\ ABS\ KEY} &= (innovation)\ OR\ DOC_{TIT\ ABS\ KEY} \\ &= (innovations)\ AND\ DOC_{TIT\ ABS\ KEY} = (shared\ mobility) \\ &= 2777\ documents \end{aligned} \quad (2)$$

where *DS* refers to detailed search and $DOC_{TIT\ ABS\ KEY}$ refers to documents that included "innovation", "innovations", and "shared mobility" terms in titles, abstracts, and keywords.

The second detailed search identified 2777 documents but, after making a detailed synthesis, it turned out that many works did not refer to transport issues. A detailed search resulted in 2777 documents, but what is more important, a more precise analysis of the obtained excerpts showed that among the documents there were works that referred to car-sharing in a very general way, for example, indicating it only in the form of a keyword of a given scientific work. Therefore, it was decided to perform a third, even more precise and limited search, according to formula (3):

$$\begin{aligned} PS = DOC_{TIT\ ABS\ KEY} &= (shared)\ OR\ DOC_{TIT\ ABS\ KEY} \\ &= (mobility) OR\ DOC_{TIT\ ABS\ KEY} (innovation)\ OR\ DOC_{TIT\ ABS\ KEY} \\ &= (transportation) = 106\ documents \end{aligned} \quad (3)$$

where *PS* refers to precise search.

The defined documents were analyzed in detail in terms of factors affecting carsharing, and the results are presented in the next section.

4. Results

The literature analysis made it possible to state that generally, the identified works refer to innovations in shared mobility services. However, this does not apply to the full number of 106 works. After a detailed synthesis and exclusion of works in which innovations appeared only as a single slogan (e.g., innovations appeared in the title or content of the work but were not a leading topic in the work) or where shared mobility was discussed but was understood to mean ride-sharing, taxi sharing, or public transportation

connected to sharing of journeys (as opposed to sharing of vehicles), at least 21 articles related to innovations in shared mobility remained.

Table 2 presents a detailed summary of the identified works, together with information about the type of innovation discussed in the given work, its detailed features, and an indication of whether the research work concerned open or closed innovations.

Table 2. Topics of innovation in works on shared mobility: summary.

Ref.	Research Topic/Goal	Is the Work Strictly Dedicated to Innovation?	Innovation	Have Issues Related to the Development of Innovation Been Indicated?	What Issues Related to Innovation Development Have Been Addressed?	Open Innovation	Closed Innovation
[40]	Exploring the intention to adopt sustainable mobility modes of transport among young university students	NO	Shared mobility services as an innovation	YES	Economic issues or environmental concerns of citizens.	N/A	N/A
[41]	The future of public transit and shared mobility: policy actions and research options for COVID-19 recovery	NO	Shared mobility services after the COVID-19 pandemic	YES	Innovative management at the policy level.	N/A	N/A
[42]	Visual communication in shared mobility systems as an opportunity for recognition and competitiveness in smart cities	NO	Labeling of shared mobility vehicles and their perception by the public	YES	Tips on choosing the right branding and how to interact with customers in terms of visual communication.	YES	NO
[43]	Aligning users' and stakeholders' needs: How incentives can reshape the carsharing market	NO	Technological innovations that influenced the development of car-sharing	YES	Advances in mobile technology, increased range of electric cars), and the establishment of new business models helped brand carsharing as a sustainable yet flexible and personalized mobility alternative.	N/A	N/A
[44]	Understanding spatiotemporal trip purposes of urban micro-mobility from the lens of dockless e-scooter sharing	NO	E-scooter sharing as an innovation	YES	Insights for city authorities and dockless e-scooter companies into more sustainable urban transportation planning and more efficient vehicle fleet reallocation.	N/A	N/A

Table 2. *Cont.*

Ref.	Research Topic/Goal	Is the Work Strictly Dedicated to Innovation?	Innovation	Have Issues Related to the Development of Innovation Been Indicated?	What Issues Related to Innovation Development Have Been Addressed?	Open Innovation	Closed Innovation
[45]	Roadmap for future mobility development supporting Bangkok urban living in 2030	NO	Scenarios for the development of shared mobility services as an innovation	YES	Approaching the law, infrastructure, and operational issues of systems to create innovative services.	N/A	N/A
[46]	Open innovation—opportunities or nightmares for the shared transport services sector?	YES	Perception of open innovations by shared mobility operators	YES	To increase the dynamics of the development of open innovation in the shared transport industry, there is a need for education in the field of open innovation, especially in the era of the development of digitization of urban transport systems and the pursuit of sustainable transport.	YES	YES
[47]	Implications of COVID-19 pandemic on the governance of passenger mobility innovations in Europe	YES	Governance of disruptive mobility innovations before and after the pandemic	NO	More collaborative, adaptive, and performance-based governance is needed; an inclusive and proactive regulatory approach is mandatory when creating innovative services.	N/A	N/A
[48]	Who will use new mobility technologies? Exploring demand for shared, electric, and automated vehicles in three Canadian metropolitan regions	NO	Shared mobility as an innovation	NO	Travel patterns, demographics, values, lifestyles, and environmental concern as main triggers of innovation.	N/A	N/A
[49]	Sharing vehicles or sharing rides—psychological factors influencing the acceptance of carsharing and ridepooling in Germany	NO	Shared mobility as an innovation	YES	Perceived compatibility with daily life is the most important factor related to the acceptance of carsharing.	N/A	N/A

Table 2. *Cont.*

Ref.	Research Topic/Goal	Is the Work Strictly Dedicated to Innovation?	Innovation	Have Issues Related to the Development of Innovation Been Indicated?	What Issues Related to Innovation Development Have Been Addressed?	Open Innovation	Closed Innovation
[50]	Open innovation business model as an opportunity to enhance the development of sustainable shared mobility industry	YES	Open business model as an innovation	YES	Development of the concept of an open business model based on the idea of open innovation and issues such as data sharing, access to customer opinions, and public–private partnership.	YES	YES
[51]	Sustainable innovation for shared mobility: contextual and consumer factors of an Indian car subscription business model	YES	Subscription business model as an innovation	YES	Willingness, financial affordability, location, and experience were identified as the key factors that should be related to carsharing innovations.	N/A	N/A
[52]	Cycling analytics for urban environments: from vertical models to horizontal innovation	YES	Bike sharing as an innovation	YES	Set of key design principles for the development of a digital platform strategy for cycling analytics.	YES	N/A
[53]	Transitioning to electrified, automated, and shared mobility in an African context: a comparative review of Johannesburg	YES	Shared mobility as an innovation	YES	Main factors that may influence the development of shared mobility in the African market, taking into account its culture and spatial issues.	N/A	N/A
[10]	Open innovation in the shared mobility market	YES	To analyze the factors influencing the limitations in the development of open innovations in the form of Mobility as a Service (MaaS) services	YES	Four groups of factors that are barriers to open innovation implementation.	YES	YES

Table 2. *Cont.*

Ref.	Research Topic/Goal	Is the Work Strictly Dedicated to Innovation?	Innovation	Have Issues Related to the Development of Innovation Been Indicated?	What Issues Related to Innovation Development Have Been Addressed?	Open Innovation	Closed Innovation
[54]	Mobility-as-a-service: concepts and theoretical approach	NO	MaaS barriers of development	YES	Barriers of innovations development: deficiency of cooperation, digital illiteracy, and unfavorable government policies.	N/A	N/A
[55]	Emerging diffusion barriers of shared mobility services in Korea	YES	Barriers of shared mobility	YES	Not only technical efforts, but also discussions with various stakeholders and efforts to minimize industrial and legal resistance, are required to effectively spread innovative services	N/A	N/A
[56]	Good practices for advancing urban mobility innovation: a case study of one-way carsharing	YES	Systematic and balanced public–private approach to foster transportation innovation management	YES	Framework to help governments and companies collaborate (organizational structures, project management processes, and profitability assessment tools). First, public and private players should have specific organizations, separated from the core business. Second, they should comanage innovation, since pilot projects lack certainty and require risk management. Third, a new approach to value emphasizing the role of project learning and capability building is necessary.	N/A	N/A
[57]	Access-based business model innovation in frontier markets: case study of shared mobility in Timor-Leste	YES	Comprehensive framework for access-based business model innovation in frontier markets	YES	Factors such as the institutional environment, industry dynamics, and infrastructural development will guide decision-makers to improve services.	N/A	N/A

Table 2. *Cont.*

Ref.	Research Topic/Goal	Is the Work Strictly Dedicated to Innovation?	Innovation	Have Issues Related to the Development of Innovation Been Indicated?	What Issues Related to Innovation Development Have Been Addressed?	Open Innovation	Closed Innovation
[58]	Business model blueprints for the shared mobility hub network	YES	Shared electric mobility as an innovation	YES	Closed mobility hub networks are an innovative solution for shared mobility and supporting interoperability, sustainable land use, and ensured access to shared (electric) travel modes. However, which kind of network the local key stakeholders need to commit to depends on local policy goals and regulatory context.	N/A	N/A
[59]	How to measure the impacts of shared automated electric vehicles on urban mobility	YES	Shared automated electric vehicles as innovation	YES	Intermodality, system interoperability, and services integration are factors that should be considered when creating innovative services.	N/A	N/A

The literature analysis performed indicates that in the case of the issue of innovation of shared mobility, it is the services themselves that are considered innovative by scientists. Scientists consider them from various aspects. Among them, however, five research trends can be identified:

(1) Business model analysis;
(2) Analyzes policies concerning sustainable development;
(3) The situation during or after the COVID-19 pandemic;
(4) Adjusting services to the needs of users or examining the level of their acceptance by society;
(5) Studies of good practices and the transition from classic forms of transport to shared mobility.

Interestingly, from the point of view of issues that should be taken into account to increase the level of innovation of services, general statements are indicated in the works, such as, for example, economic issues or environmental concerns of society; innovative management; more sustainable urban transportation planning; more effective fleet relocation; approaching the law; infrastructure and operational issues of systems; education in the field of open innovation; collaborative, adaptive, and performance-based governance; inclusive and proactive regulatory approach; travel patterns; demographics; values; lifestyles; and compatibility of the services with daily life, without specifying detailed service improvement guidelines.

It is important to emphasize that in the vast majority of works, the issues of open innovation are niche aspects. Among the analyzed articles, only 5 papers devoted directly to open innovations in shared mobility were defined, which means that 76% of the research published on innovations in shared mobility did not directly concern open innovations.

However, what is interesting, despite the lack of indications of links with open innovations, is that scientists, in their work, pointed to aspects that can be associated with an open type of innovation, such as interoperability of systems, creating a network of stakeholders, public–private partnership, or cooperation with competitors and customers. It seems, therefore, that knowledge about open innovations may be too little disseminated among scientists conducting research in the field of shared mobility concerning, for example, classical research on management, marketing, taxonomy, or entrepreneurship [18,56,57].

The need to popularize knowledge about innovations and open innovations in the field of shared mobility seems to be very necessary, especially considering real market practices. Currently, following the implementation of the assumptions of sustainable transport, new mobility development policies aim at the universal implementation of Mobility as a Service (MaaS) systems, i.e., combining various transport services into one coherent system, available on demand [58,59]. This type of connection requires the sharing of data, the establishment of public–private partnerships, and the sharing of a great amount of information on operational aspects of the systems, location of vehicles, number of vehicles, and customer bases [59]. These aspects are often perceived by business operators as confidential, and they are reluctant to share any knowledge or information regarding their activities [46]. Market practices of this kind indicate a disturbance of open innovation which, in the future, through inadequate adjustment of business models of services, may translate into a temporary or complete closure of shared mobility systems due to failure to adapt to the new standards of cooperation following the idea of openness. Importantly, it is worth highlighting that shared mobility, following the principles of a collaborative economy, should function based on the openness of both data and resources [60,61]. For this reason, data sharing should be a basic requirement of operators [62–65]. Furthermore, from the point of view of open innovation, the sharing of open data should be particularly important in shared mobility. It is especially important, in times of current crises (such as the COVID-19 pandemic), to remember that open innovation may be a way to survive in the market, to ensure the long-term profitability of companies, and to achieve a real level of sustainable development of the shared mobility industry. Therefore, the popularization of knowledge about open innovations, both in the case of shared mobility operators as well as scientists who research this type of service, seems to be highly recommended.

It is also worth emphasizing that business practices go much further than the provision of typical short-term vehicle rental services. Business practices that are referred to in the market as innovative include, among others:

- Package services;
- Possibility of long-term rental;
- Vehicle delivery services directly to the user;
- Awards for responsible drivers, including those who follow the rules of eco-driving;
- Access to premium vehicles for experienced customers;
- Modernization of the fleet;
- Increasing the autonomy of systems by increasingly reducing the need to contact customer service offices, creating mobility hubs;
- Development of heat maps of service availability;
- Developing offers for companies to use shared mobility vehicles as an alternative to business fleets;
- Provision of additional vehicle equipment;
- Discounts and rebates for carrying out touch services, e.g., refueling or washing the vehicle by the user;
- Additional sanitary restrictions related to the desire to control the spread of viruses;
- The possibility of renting vehicles through applications that are generators of travel and joint mobility with other forms of transport.

It is important to note that the practices mentioned above, generally, have not been addressed in scientific works in the context of innovations used in shared mobility systems. Therefore, it is worth paying attention to the need to expand this research gap among

scientists to provide those seeking information with reliable and valuable scientific works on current trends in shared mobility services.

5. Conclusions

To sum up, as part of the literature review, it was possible to achieve the research goal of determining the interest of scientists in the issues of innovation in shared mobility services. Based on the achieved results, it can be concluded that innovations in shared mobility are a niche topic considered in few scientific works. In addition, significantly, if the topic of innovation appears in scientific research, as identified in the literature review, it refers to the fact that shared mobility services are perceived as innovative in themselves. Interestingly, comparing the obtained results with business practices described as innovative, it can be stated that scientists, in their work, do not deal with current shared mobility business trends. Moreover, the study showed that the subject of open innovation concerning shared mobility is not popular among scientists, even though they indicate the elements of shared mobility to be used.

The study made it possible to identify five main areas for considering innovations in shared mobility, i.e., business models, sustainable development, aspects related to COVID-19, acceptance of services, and good business practices. While shared mobility services were scantly considered in terms of innovation, no scientific article was identified that analyzed shared mobility in terms of the main areas of business innovation, i.e., strategy innovation, organizational innovation, technology innovation, process innovation, service innovation, product innovation, and marketing innovation [66,67]. For scientists, this indicates which aspects are worth researching in the future. Moreover, scientists are recommended to familiarize themselves with open innovative solutions for shared mobility, especially in the era of the need to implement open systems and new mobility, and they are recommended to create service accelerators, the functioning of which is based on mutual data exchange and information sharing. It is also recommended to increase cooperation of shared mobility services in the field of scientist–operators in order to increase the flow of information on business practices that are actually applied; this will allow for a wider dissemination of knowledge about innovations.

The study showed that innovations, such as open innovations, holds the potential to become an interesting research field for scientists from around the world, due to the insufficient number of studies in the field of shared mobility. Demonstrating innovation trends in shared mobility systems and conducting detailed research in their field, starting from social, economic, transport or legal issues, may translate into a better recognition of services and increase their use, which is the basis for the development of modern smart cities. In subsequent works, the author plans to focus on market research in the field of open innovation in the shared mobility market.

Like any work, this one has research limitations. The main limitation is that the research scope related to the search for works referred to only two scientific databases. Although these were the leading bibliographic databases, they may not have included all the publications on innovations in shared mobility services. Therefore, in subsequent studies, the author plans to include other scientific bases. Another limitation may be the language of published works. This study focuses only on works published in English, which does not mean that there are no works on the analyzed topic in other languages. These works may not be as accessible as those in English. The last of the limitations may be the scope of searches and developed mathematical formulas imposing detailed search restrictions. The introduced restrictions may have limited the scope of searches and omitted some studies, but the proposed method allowed for the review of 22,147 documents, which would be very time-consuming to carry out manually.

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References

1. Zhang, X.; Shao, C.; Wang, B.; Huang, S.; Mi, X.; Zhuang, Y. Exploring the Role of Shared Mobility in Alleviating Private Car Dependence and On-Road Carbon Emissions in the Context of COVID-19. *Front. Environ. Sci.* **2022**, *10*, 931763. [CrossRef]
2. Guyader, H.; Friman, M.; Olsson, L.E. Shared Mobility: Evolving Practices for Sustainability. *Sustainability* **2021**, *13*, 12148. [CrossRef]
3. Statista Potal. Shared Mobility Worldwide. Available online: https://www.statista.com/outlook/mmo/shared-mobility/worldwide (accessed on 15 April 2023).
4. Boutueil, V.; Nemett, L.; Quillerier, T. Trends in Competition among Digital Platforms for Shared Mobility: Insights from a Worldwide Census and Prospects for Research. *Transp. Res. Rec.* **2022**, *2676*, 69–82. [CrossRef]
5. Martin, L. Rebalancing in Shared Mobility Systems–Competition, Feature-Based Mode Selection and Technology Choice. In *Operations Research Proceedings 2021*; Trautmann, N., Gnägi, M., Eds.; Lecture Notes in Operations Research; Springer International Publishing: Cham, Switzerland, 2022; pp. 33–38. [CrossRef]
6. Martin, G.; Donain, M.; Fromont, E.; Guns, T.; Roze, L.; Termier, A. Prediction-Based Fleet Relocation for Free Floating Car Sharing Services. In Proceedings of the 2021 IEEE 33rd International Conference on Tools with Artificial Intelligence (ICTAI), Washington, DC, USA, 1–3 November 2021; IEEE: Washington, DC, USA, 2021; pp. 1187–1191. [CrossRef]
7. Lu, M.; Chen, Z.; Shen, S. Optimizing the Profitability and Quality of Service in Carshare Systems Under Demand Uncertainty. *Manuf. Serv. Oper. Manag.* **2018**, *20*, 162–180. [CrossRef]
8. Turoń, K.; Kubik, A.; Chen, F. What Car for Car-Sharing? Conventional, Electric, Hybrid or Hydrogen Fleet? Analysis of the Vehicle Selection Criteria for Car-Sharing Systems. *Energies* **2022**, *15*, 4344. [CrossRef]
9. Hahn, R.; Ostertag, F.; Lehr, A.; Büttgen, M.; Benoit, S. "I like It, but I Don't Use It": Impact of Carsharing Business Models on Usage Intentions in the Sharing Economy. *Bus. Strategy Environ.* **2020**, *29*, 1404–1418. [CrossRef]
10. Turoń, K.; Kubik, A. Open Innovation in the Shared Mobility Market. *JOItmC* **2021**, *7*, 212. [CrossRef]
11. Aguilera-García, Á.; Gomez, J.; Antoniou, C.; Vassallo, J.M. Behavioral Factors Impacting Adoption and Frequency of Use of Carsharing: A Tale of Two European Cities. *Transp. Policy* **2022**, *123*, 55–72. [CrossRef]
12. Aguilera-García, Á.; Gomez, J.; Sobrino, N.; Vinagre Díaz, J.J. Moped Scooter Sharing: Citizens' Perceptions, Users' Behavior, and Implications for Urban Mobility. *Sustainability* **2021**, *13*, 6886. [CrossRef]
13. Carrese, S.; D'Andreagiovanni, F.; Giacchetti, T.; Nardin, A.; Zamberlan, L. A Beautiful Fleet: Optimal Repositioning in E-Scooter Sharing Systems for Urban Decorum. *Transp. Res. Procedia* **2021**, *52*, 581–588. [CrossRef]
14. Chang, S.; Song, R.; He, S.; Qiu, G. Innovative Bike-Sharing in China: Solving Faulty Bike-Sharing Recycling Problem. *J. Adv. Transp.* **2018**, *2018*, 1–10. [CrossRef]
15. Long, T.B.; van Waes, A. When Bike Sharing Business Models Go Bad: Incorporating Responsibility into Business Model Innovation. *J. Clean. Prod.* **2021**, *297*, 126679. [CrossRef]
16. Félix, R.; Orozco-Fontalvo, M.; Moura, F. Socio-Economic Assessment of Shared e-Scooters: Do the Benefits Overcome the Externalities? *Transp. Res. Part D Transp. Environ.* **2023**, *118*, 103714. [CrossRef]
17. Abouelela, M.; Chaniotakis, E.; Antoniou, C. Understanding the Landscape of Shared-e-Scooters in North America; Spatiotemporal Analysis and Policy Insights. *Transp. Res. Part A Policy Pract.* **2023**, *169*, 103602. [CrossRef]
18. Istudor, N.; Ignat, R.; Petrescu, I.-E.; Constantin, M.; Chiripuci, B.C. Exploring Consumer Preferences for Shared Mobility Services in the Big Cities of Europe. Socio-Economic and Sustainability Concerns in the Era of COVID-19. *Int. J. Transp. Econ.* **2022**, *49*, 173–205.
19. Haddad, H.; Bouyahia, Z.; Horchani, L. On the Sustainability of Shared Mobility Since COVID-19: From Socially Structured to Social Bubble Vanpooling. *Sustainability* **2022**, *14*, 15764. [CrossRef]
20. Shokouhyar, S.; Shokoohyar, S.; Sobhani, A.; Gorizi, A.J. Shared Mobility in Post-COVID Era: New Challenges and Opportunities. *Sustain. Cities Soc.* **2021**, *67*, 102714. [CrossRef]
21. Chesbrough, H. Managing Open Innovation. *Res.-Technol. Manag.* **2004**, *47*, 23–26. [CrossRef]
22. Schumpeter, J.A. The theory of economic development. In *An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*; Harvard University Press: Cambridge, MA, USA, 1934.

23. Lee, S.M.; Trimi, S. Innovation for Creating a Smart Future. *J. Innov. Knowl.* **2018**, *3*, 1–8. [CrossRef]
24. Felin, T.; Zenger, T.R. Closed or Open Innovation? Problem Solving and the Governance Choice. *Res. Policy* **2014**, *43*, 914–925. [CrossRef]
25. Chesbrough, H.W. *Open Innovation: The New Imperative for Creating and Profiting from Technology*; Harvard Business School Press: Boston, MA, USA, 2011.
26. Harrison, C.; Eckman, B.; Hamilton, R.; Hartswick, P.; Kalagnanam, J.; Paraszczak, J.; Williams, P. Foundations for Smarter Cities. *IBM J. Res. Dev.* **2010**, *54*, 1–16. [CrossRef]
27. Attour, A.; Dominguez-Péry, C.; Bendavid, Y. Information Technologies, Knowledge and Innovation in Smart Cities: Current and Future Trends for Management Research. *Systèmes D'information Manag.* **2022**, *26*, 3–18. [CrossRef]
28. Gupta, A.; Panagiotopoulos, P.; Bowen, F. An Orchestration Approach to Smart City Data Ecosystems. *Technol. Forecast. Soc. Chang.* **2020**, *153*, 119929. [CrossRef]
29. Guo, Y.-M.; Huang, Z.-L.; Guo, J.; Li, H.; Guo, X.-R.; Nkeli, M.J. Bibliometric Analysis on Smart Cities Research. *Sustainability* **2019**, *11*, 3606. [CrossRef]
30. Griffinger, R. Smart Cities. Ranking of European Medium-Sized Cities. Available online: https://www.smart-cities.eu/download/smart_cities_final_report.pdf (accessed on 15 April 2023).
31. Battarra, R.; Gargiulo, C.; Pappalardo, G.; Boiano, D.A.; Oliva, J.S. Planning in the era of Information and Communication Technologies. Discussing the "label: Smart" in South-European cities with environmental and socio-economic challenges. *Cities* **2016**, *59*, 1–7. [CrossRef]
32. Burlacu, M.; Boboc, R.G.; Butilă, E.V. Smart Cities and Transportation: Reviewing the Scientific Character of the Theories. *Sustainability* **2022**, *14*, 8109. [CrossRef]
33. Kamargianni, M.; Li, W.; Matyas, M.; Schäfer, A. A Critical Review of New Mobility Services for Urban Transport. *Transp. Res. Procedia* **2016**, *14*, 3294–3303. [CrossRef]
34. Butler, L.; Yigitcanlar, T.; Paz, A. How Can Smart Mobility Innovations Alleviate Transportation Disadvantage? Assembling a Conceptual Framework through a Systematic Review. *Appl. Sci.* **2020**, *10*, 6306. [CrossRef]
35. Booth, A.; Sutton, A.; Papaioannou, D. *Systematic Approaches to a Successful Literature Review*; SAGE Publications: London, UK, 2012.
36. Pranckutė, R. Web of Science (WoS) and Scopus: The Titans of Bibliographic Information in Today's Academic World. *Publications* **2021**, *9*, 12. [CrossRef]
37. Li, K.; Rollins, J.; Yan, E. Web of Science Use in Published Research and Review Papers 1997–2017: A Selective, Dynamic, Cross-Domain, Content-Based Analysis. *Scientometrics* **2018**, *115*, 1–20. [CrossRef]
38. Baas, J.; Schotten, M.; Plume, A.; Côté, G.; Karimi, R. Scopus as a Curated, High-Quality Bibliometric Data Source for Academic Research in Quantitative Science Studies. *Quant. Sci. Stud.* **2020**, *1*, 377–386. [CrossRef]
39. Cronin, P.; Ryan, F.; Coughlan, M. Undertaking a Literature Review: A Step-by-Step Approach. *Br. J. Nurs.* **2008**, *17*, 38–43. [CrossRef]
40. Rodríguez-Rad, C.J.; Revilla-Camacho, M.-Á.; Sánchez-del-Río-Vázquez, M.-E. Exploring the Intention to Adopt Sustainable Mobility Modes of Transport among Young University Students. *IJERPH* **2023**, *20*, 3196. [CrossRef] [PubMed]
41. Shaheen, S.; Wong, S. The Future of Public Transit and Shared Mobility: Policy Actions and Research Options for COVID-19 Recovery. In *Pandemic in the Metropolis*; Loukaitou-Sideris, A., Bayen, A.M., Circella, G., Jayakrishnan, R., Eds.; Springer Tracts on Transportation and Traffic; Springer International Publishing: Cham, Switzerland, 2023; Volume 20, pp. 313–331. [CrossRef]
42. Turoń, K.; Kubik, A.; Ševčovič, M.; Tóth, J.; Lakatos, A. Visual Communication in Shared Mobility Systems as an Opportunity for Recognition and Competitiveness in Smart Cities. *Smart Cities* **2022**, *5*, 802–818. [CrossRef]
43. Cantelmo, G.; Amini, R.E.; Monteiro, M.M.; Frenkel, A.; Lerner, O.; Tavory, S.S.; Galtzur, A.; Kamargianni, M.; Shiftan, Y.; Behrischi, C.; et al. Aligning Users' and Stakeholders' Needs: How Incentives Can Reshape the Carsharing Market. *Transp. Policy* **2022**, *126*, 306–326. [CrossRef]
44. Li, H.; Yuan, Z.; Novack, T.; Huang, W.; Zipf, A. Understanding Spatiotemporal Trip Purposes of Urban Micro-Mobility from the Lens of Dockless e-Scooter Sharing. *Comput. Environ. Urban Syst.* **2022**, *96*, 101848. [CrossRef]
45. Gerdsri, N.; Sivara, K.; Chatunawarat, C.; Jaroonjitsathian, S.; Tundulyasaree, K. Roadmap for Future Mobility Development Supporting Bangkok Urban Living in 2030. *Sustainability* **2022**, *14*, 9296. [CrossRef]
46. Turoń, K.; Kubik, A. Open Innovation—Opportunities or Nightmares for the Shared Transport Services Sector? *JOItmC* **2022**, *8*, 101. [CrossRef]
47. Tsvetkova, A.; Kulkov, I.; Busquet, C.; Kao, P.-J.; Kamargianni, M. Implications of COVID-19 Pandemic on the Governance of Passenger Mobility Innovations in Europe. *Transp. Res. Interdiscip. Perspect.* **2022**, *14*, 100581. [CrossRef]
48. Long, Z.; Axsen, J. Who Will Use New Mobility Technologies? Exploring Demand for Shared, Electric, and Automated Vehicles in Three Canadian Metropolitan Regions. *Energy Res. Soc. Sci.* **2022**, *88*, 102506. [CrossRef]
49. Burghard, U.; Scherrer, A. Sharing Vehicles or Sharing Rides-Psychological Factors Influencing the Acceptance of Carsharing and Ridepooling in Germany. *Energy Policy* **2022**, *164*, 112874. [CrossRef]
50. Turoń, K. Open Innovation Business Model as an Opportunity to Enhance the Development of Sustainable Shared Mobility Industry. *JOItmC* **2022**, *8*, 37. [CrossRef]

51. Chaudhuri, R.; Chatterjee, S.; Ghosh, A.; Vrontis, D.; Thrassou, A. Sustainable Innovation for Shared Mobility: Contextual and Consumer Factors of an Indian Car Subscription Business Model. *IJEBR*, 2022; *ahead-of-print*. [CrossRef]
52. Carvalho, C.; Pessoa, R.; José, R. Cycling Analytics for Urban Environments: From Vertical Models to Horizontal Innovation. In *Intelligent Transport Systems*; Martins, A.L., Ferreira, J.C., Kocian, A., Eds.; Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering; Springer International Publishing: Cham, Switzerland, 2022; Volume 426, pp. 135–148. [CrossRef]
53. Sovacool, B.K.; Daniels, C.; AbdulRafiu, A. Transitioning to Electrified, Automated and Shared Mobility in an African Context: A Comparative Review of Johannesburg, Kigali, Lagos and Nairobi. *J. Transp. Geogr.* **2022**, *98*, 103256. [CrossRef]
54. Sulskyte, D. Mobility-As-A-Service: Concepts and Theoretical Approach. In Proceedings of the 2021 IEEE International Conference on Technology and Entrepreneurship (ICTE), Virtual, 24–27 August 2021; IEEE: Kaunas, Lithuania, 2021; pp. 1–6. [CrossRef]
55. Kim, S.; Lee, H.; Son, S.-W. Emerging Diffusion Barriers of Shared Mobility Services in Korea. *Sustainability* **2021**, *13*, 7707. [CrossRef]
56. Terrien, C.; Maniak, R.; Chen, B.; Shaheen, S. Good Practices for Advancing Urban Mobility Innovation: A Case Study of One-Way Carsharing. *Res. Transp. Bus. Manag.* **2016**, *20*, 20–32. [CrossRef]
57. Wiprächtiger, D.; Narayanamurthy, G.; Moser, R.; Sengupta, T. Access-Based Business Model Innovation in Frontier Markets: Case Study of Shared Mobility in Timor-Leste. *Technol. Forecast. Soc. Chang.* **2019**, *143*, 224–238. [CrossRef]
58. Coenegrachts, E.; Beckers, J.; Vanelslander, T.; Verhetsel, A. Business Model Blueprints for the Shared Mobility Hub Network. *Sustainability* **2021**, *13*, 6939. [CrossRef]
59. Nemoto, E.H.; Issaoui, R.; Korbee, D.; Jaroudi, I.; Fournier, G. How to Measure the Impacts of Shared Automated Electric Vehicles on Urban Mobility. *Transp. Res. Part D Transp. Environ.* **2021**, *93*, 102766. [CrossRef]
60. Haapalainen, P.; Kantola, J. Taxonomy of Knowledge Management in Open Innovations. *Procedia Manuf.* **2015**, *3*, 688–695. [CrossRef]
61. Jelonek, D. The Role of Open Innovations in the Development of E-Entrepreneurship. *Procedia Comput. Sci.* **2015**, *65*, 1013–1022. [CrossRef]
62. Narayanan, S.; Antoniou, C. Shared Mobility Services towards Mobility as a Service (MaaS): What, Who and When? *Transp. Res. Part A Policy Pract.* **2023**, *168*, 103581. [CrossRef]
63. Smith, G.; Hensher, D.A. Towards a Framework for Mobility-as-a-Service Policies. *Transp. Policy* **2020**, *89*, 54–65. [CrossRef]
64. Le Vine, S.; Polak, J. Introduction to Special Issue: New Directions in Shared-Mobility Research. *Transportation* **2015**, *42*, 407–411. [CrossRef]
65. Yanocha, D.; Mason, J.; Hagen, J. Using Data and Technology to Integrate Mobility Modes in Low-Income Cities. *Transp. Rev.* **2021**, *41*, 262–284. [CrossRef]
66. Knoke, B.; Eschenbaecher, J. KPIs to Manage Innovation Processes in VEEs–Initial Thoughts and Results. Available online: https://ceur-ws.org/Vol-864/paper_3.pdf (accessed on 15 April 2023).
67. Ariza, C.; Rugeles, L.; Saavedra, D.; Guaitero, B. Measuring Innovation in Agricultural Firms: A Methodological Approach. *Electron. J. Knowl. Manag.* **2013**, *11*, 185–198.