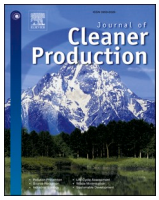
Journal of Cleaner Production 485 (2024) 144333

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro



Connecting smart mobility and car sharing using a systematic literature review. An outlook using Bibliometrix

Elena-Mădălina Vătămănescu [a], Gandolfo Dominici [b,*], Victor-Emanuel Ciuciuc [a], Alexandra Vițelar [a], Flavia Gabriela Anghel [a]

[a] Faculty of Management, National University of Political Studies and Public Administration (SNSPA), Bucharest, Romania
[b] University of Palermo, Department of Economical, Business and Statistical Sciences (DSEAS), 90128, Palermo, Italy

ARTICLE INFO

Handling Editor: Christian Garaus

Keywords:
Smart mobility
Car sharing
Sustainable transportation
Electric vehicles
Systematic literature review
Bibliometric analysis

ABSTRACT

Car sharing (CS) and smart mobility have emerged as pivotal components for a sustainable transformation in urban transportation, standing out as central topics in the discussions on sustainable mobility solutions. Nevertheless, the increasing interest from scholars, CS companies' owners, and policymakers in car sharing services as a viable response to the sustainable urban transport has availed rather mixed considerations, thus calling for further scrutiny. The current endeavor thus seeks to advance a systematic literature review of the body of knowledge correlatively addressing the issues of various forms of smart mobility and car sharing. Four major research questions are envisaged, namely: What are the bibliometric characteristics of the literature related to smart mobility and car sharing? What is the focus of this literature in terms of key concepts? What are the limitations of the existing body of literature? and What are the implications of this literature in terms of future research avenues? With a view to providing pertinent answers, emphasis will be laid on the insights, critique, and transformative redefinitions of the literature in the field via a bibliometric analysis and structured theme-based review. The SPAR-4-SLR protocol is employed while the data retrieved from the Scopus database was processed with the Bibliometrix package (i.e., Biblioshiny) of the R study program. Derived from the thematic mapping and the identified clusters, six key research topics (i.e., car sharing through the lens of urban mobility management, innovative business models and governance, sustainable transportation and e-car sharing, smart mobility and multimodality, sustainable mobility, public transport, and collaborative consumption, climate change and electric vehicles and transport policy and automotive industry) are thoroughly discussed in terms of added value and limitations. The findings manage to clarify the multiplexity of links between the two constructs, by shedding light on the motor, basic, niche, emerging and declining themes which are worthy of further consideration within a structured research agenda. Additionally, they point to the fact that the issues of smart mobility and car sharing are still producing mixed or fragmented conclusions in terms of socio-economic, technological and environmental impacts, calling for further investigation. Manifold implications of the state-of-the-art in the field are brought to the attention of scholars and practitioners interested in achieving a better understanding and integration of car sharing and smart mobility in the broad transport ecosystem.

1. Introduction

Car sharing and smart mobility steadily stand out as key changes for a sustainable paradigm shift in urban transport being nowadays one of the foremost subjects of discussions on sustainable mobility solutions. Over the last years, the growth of interest of policymakers in car sharing services as a likely solution for sustainable urban transport has been fueled by the growth of the general interest in smart and sustainable cities. In the European Union, the 2019 Strategic Transport Research and Innovation Agenda (STRIA) by the European Commission delineated the future transport research and innovation roadmaps to reduce CO2 emission in the European transport sector. The STRIA roadmaps are: Connected and Automated Transport (CAT), Smart Mobility and Services (SMO), Transport Electrification (ELT), Low Emission

* Corresponding author.
E-mail addresses: madalina.vatamanescu@facultateademanagement.ro (E.-M. Vătămănescu), gandolfo.dominici@unipa.it (G. Dominici), victor.ciuciuc@facultateademanagement.ro (V.-E. Ciuciuc), alexandra.vitelar@facultateademanagement.ro (A. Vițelar), flavia.anghel@facultateademanagement.ro (F.G. Anghel).

https://doi.org/10.1016/j.jclepro.2024.144333
Received 17 October 2023; Received in revised form 3 November 2024; Accepted 25 November 2024
Available online 27 November 2024

Alternative Energy (ALT), Transport Infrastructure (INF), Network and Traffic Management Systems (NTM), Vehicle Design and Manufacturing (VDM). In particular, the SMO roadmap has founded 757 projects for a total of €993.000.000 to find smart and sustainable solutions for smart mobility (European Commission, 2019). In the European Union, the Transport Research and Innovation Monitoring and Information System (TRIMIS) was established by the European Commission' and published report in 2022 about: "Research and innovation in car sharing in Europe" analyzing ap-proximately 9000 projects. From this study emerged that most of the projects target urban environment and on the development of smart solutions such as apps and connected cars. The interest and wide investment of policymakers created a growing focus of research in various fields such as: business, transport, smart and sustainable technology, and urban design.

The literature published over the past fifteen years has insisted on various aspects integrating car sharing and smart mobility. As retrieved from the Scopus database (13 systematic literature reviews and bibliometric analyses) were published between 2010 and 2024 on topics related to car sharing and smart mobility. The analyzed units (i.e., articles) ranged from 24 to 580, emphasis being placed on either car sharing theoretical developments or smart mobility technologies and challenges. Even if when both topics and the related dimensions are under scrutiny, the focus is often on a single construct while the other is discussed rather tangentially (please see Appendix, Table 1A). At this level, the aim of the current endeavor is to equally treat both constructs and their manifold facets, showcasing their interactions, complementarity and ways to reach their potential by addressing existing gaps.

To start with, shared mobility, including car sharing, has been proved to significantly reduce vehicle ownership, emissions, and traveled kilometers (Günther et al., 2020). The same approaches are given way by Jonuschat et al. (2015) who demonstrate that car sharing can significantly reduce the carbon footprint of users by enabling intermodal trips and reducing private car dependence and by Stewart (2015) who highlight the potential of ICT tools to improve co-modality and reduce carbon emissions, emphasizing measures that decrease overall car usage. Nevertheless, challenging perspectives are provided by Keyvanfar et al. (2018) who compared various policies aimed at reducing fuel consumption and carbon emissions, finding car sharing and carpooling appeared to be the least investigated approaches for mitigating climate change, despite their potential benefits. From a more critical standpoint, Santos et al. (2010) urged that, although car sharing may be indicative of CO2 emissions decreasing, the aggregate reduction is yet to be precisely measured and to provide definite conclusions for transportation policymakers.

Table 1
Interrogative approach of systematic literature reviews (Paul et al., 2021).

WHAT	SLR emerges as both a pertinent *methodology* for and a *product* of scholarly research, being designed as a domain-based review concentrated on a topic of interest (i.e., the correlative study of smart mobility and car sharing). It is manifested via two main ways: 1. a bibliometric review underscoring statistics and trends in the review domain and 2. a structured theme-based review revolving around the pivotal constructs and theoretical approaches in the review domain.
WHY	SLR aims to provide an accurate state-of-the-art in the relatively new review domain as a steppingstone for giving way to further research avenues in a knowledgeable and innovative manner.
WHEN	SLR can be founded on a substantial, yet relatively new body of literature (i.e., 40 articles for review). The review domain has reached a sufficient level of maturity, thus allowing a pertinent scrutiny and potential added value by means of SLR
WHERE	SRL targets a premier journal apposite for the review domain
WHO	SRL is developed by an international and multi-expert research team
HOW	SRL is based on SPAR-4-SLR protocol which is more applicable to the review domain (i.e., management and business) than other validated protocols (e.g., PRISMA and PRISMA-P are well-reputed protocols, but they cover systematic reviews in general).

Source: Authors' own processing

Other research strands have pointed to the availability of shared mobility services which had also led to a shift in mobility patterns, with an increase in the use of bicycles, walking, and carpooling (Günther et al., 2020; Al-Addal, 2021; Zhang and Zhang, 2021). These technologies contribute to sustainable development and promote social-ecological innovation, ultimately providing greener and smarter mobility solutions to individuals (Rokicki et al., 2021). Furthermore, these technologies have a synergistic effect on each other, with the implementation of one technology leading to increased adoption and acceptance of the others. Still, the actual impact of car sharing on public transport is highly dependent on specific local conditions, including the quality and coverage of the public transport network, the design and accessibility of car sharing services, and the overall transportation policies in place. Beyond obvious benefits such as complementarity, integration opportunities, car sharing may hinder public transport demand, particularly in areas where public transit is less frequent or less comfortable (Kosunda et al., 2023), can potentially reduce the income of public transport services if ridership decreases and reduce the utilization of more environmentally friendly public transport (Vélez, 2023). If car sharing is convenient, reliable, and cost-effective, it might reduce the demand for public transport, particularly in areas where public transit is less frequent or less comfortable (Kosunda et al., 2023). In terms of **behavioral changes**, car sharing could lead to broader behavioral changes, affecting how often people choose to travel and their mode of transportation, which could indirectly affect public transit usage patterns (Nexus, 2022). Therefore, it can serve as a competitive alternative, a supplemental mode, or as part of an integrated multimodal transportation system (Wilbur et al., 2023).

Another pivotal point in the integrated study of smart mobility and car sharing covers the fact that smart mobility technologies also enhance the safety and efficiency of car sharing services. For example, the integration of GPS tracking and real-time data analysis enables car sharing platforms to monitor vehicle locations and usage patterns, ensuring that vehicles are distributed strategically across a service area (Yun et al., 2020). This helps to minimize wait times for users and improve overall efficiency. Another key factor in the influence of smart mobility on car sharing adoption is the development of mobile internet technology. The rapid advancement of mobile internet technology has facilitated greater accessibility and ease-of-use for car sharing services. Mobile applications allow users to easily locate available vehicles, reserve them in advance, unlock them with their smartphones, and make payments seamlessly. This level of convenience and user-friendly experience has significantly contributed to the popularity and adoption of car sharing among users (Hossain et al., 2022a,b; Roblek et al., 2021).

However, there are opposing arguments that challenge the notion of smart mobility's influence on car sharing adoption. While smart mobility technologies may enhance the convenience and efficiency of car sharing services, it does not substantiate fundamental issues such as limited options where public transportation infrastructure is lacking or unreliable (Merlin, 2017), compelling socio-demographic factors based variations (e.g., gender and intergenerational differences) (Kawgan-Kagan, 2015; Alonso-Almeida, 2019; Tran et al. (2019), safety concerns (Singh, 2020; Delgado-Fernández et al., 2022) and of data privacy and security (i.e., individuals may be wary of sharing their personal information, such as location and payment details, through smart mobility platforms) (Butler et al., 2020). In an aggregate view, the integrative study of car sharing and smart mobility should dig deeper into customers' psychological factors in terms of the technology acceptance model (TAM). Such factors are likely to impact user acceptance of the new transportation services, substantively marking the perceived system and service quality, its security and connectedness (Park and Kim, 2013). Specific calls for a critical approach in this vein are underlined more recently by Dirsehan and van Zoonen (2022) who point to the fact that the knowledge on the acceptance of the novel technologies in smart cities by citizens is still incipient and fragmented. By means of a systematic literature review, they use TAM as a reliable

filter to investigate individuals' openness toward smart city technologies and conclude that most of the studies are concerned with individual units while integrative analyses are still lacking.

Studies also overlook other relevant factors that may influence car sharing adoption. For example, little is known on the impact of factors such as social norms and peer influences (Hossain et al., 2022a,b; Jin and Chen, 2020). These factors have been found to play a significant role in shaping individuals' adoption behaviors but are often overlooked in smart mobility studies. In addition, the studies tend to focus on predictors such as mobility, automotive ownership, urban areas, environmental awareness, and technology. While these predictors provide valuable insights, they may not capture the full range of factors that influence car sharing adoption (Gu et al., 2021). Subsequently, the studies often neglect to examine the psychological determinants of car sharing success. These determinants, such as attitudes, perceptions, and motivations of individuals towards car sharing services, can greatly influence their adoption behaviors (Rohde et al., 2023).

Taking stock of the insights and criticism of the extant body of knowledge, the current study seeks to advance a bibliometric analysis and systematic literature review addressing the relationship between various forms of smart mobility and car sharing adoption. Unlike other studies (see Table 1A in Appendix) which have primarily revolved around one of the two constructs, the current undertaking aims to look into both phenomena with a view to mainstream their integrative achievements and the premises of reaching their full potential together. Pursuant to Paul and Criado (2020), the purpose is to provide solid foundations for research development, by acknowledging the added value of what has been already done, the limitations and research gaps waiting to be filled in, and the compelling points of a future research agenda on the topic. Though the literature in the field encompasses similar endeavors (i.e., systematic literature reviews, critical reviews, and bibliometric analyses), their focus and scope are substantively different. For example, via a systematic literature review and a case study of the two projects, Teles et al. (2018) examine how the product-service system (PSS) business model can engender sustainability, taking into account environmental aspects, especially related to gases emission. Storme et al. (2021) lay emphasis on the impact of new mobility services (NMS) on the social-economic and environmental facets of sustainable mobility services. Chakraborty et al. (2021) employ a bibliometric analysis to examine sustainable mobility in terms of various returns such as societal, economic and environmental. Zhu et al. (2023) avail a comprehensive review of the noteworthy relationship between sustainable transportation systems and shared mobility, by bringing forward ridesharing, car sharing, shared micromobility, on-demand ride services, and shared autonomous vehicles.

In comparison with these approaches, the added value of the current undertaking firstly lies in the advancement of a wider area of interest which covers smart mobility and car sharing issues by also considering inherent dimensions to the main constructs as derived from the specialized literature (e.g., smart/intelligent transportation, sustainable mobility/transportation). Secondly, the argumentative structure integrates a threefold analytical framework consistent with Massaro et al.'s (2016) recommendations: a. providing insights ("*How is research for inquiring into the specialized literature developing?*"), b. advancing critique (*"What is the focus and critique of the literature on the topic?"*) and c. ensuring transformative redefinitions ("*What is the future for the literature on the topic?*"). By means of a bibliometric analysis and systematic literature review of 173 peer-reviewed articles, the study sets out to answer four main research questions: RQ1. What are the bibliometric characteristics of the literature related to smart mobility and car sharing? RQ2. What is the focus of this literature in terms of key concepts? RQ3. What are the limitations of the existing body of literature? RQ4. What are the implications of this literature in terms of future research avenues? By answering these question, new insights will be brought forward so as to clarify the multiplexity of links between the terms associated with smart mobility and car sharing, to shed light on the emerging and basic themes, respectively on the motor and niche themes which are worthy of further consideration.

To this end, the remainder of the paper was organized as follows. Firstly, materials and methods are clearly introduced. Secondly, the descriptive results are presented, complemented by the literature clustering and by in-depth thematic analysis. The final section reveals the conclusion of the systematic literature review and proposes further research trajectories.

2. Methodology

Systematic literature review (SLR) methodology is a structured approach used to identify, evaluate, and synthesize the existing body of research relevant to specific research questions or topics (Paul & Criado, 2020; Secinaro et al., 2022). It involves a systematic and comprehensive search of various databases, screening and selecting relevant articles, extracting data from the selected studies, assessing their quality and bias risk using predetermined criteria, and ultimately synthesizing the findings to draw meaningful conclusions as prerequisites for future research developments.

Consistent with Elsbach and van Knippenberg's (2020, p. 1227) perspective, systematic literature reviews are "among the most useful vehicles for advancing knowledge and furthering research". They have the potential to generate added value for wide audiences if they manage to cover and look into the existing knowledge, to pinpoint the main research problems and gaps and to advance pertinent knowledge to be further scrutinized with a view to improving the acumen in the field (Paul and Criado, 2020).

Giving credit to the interrogative approach proposed by Paul et al. (2021) – i.e., "what," "why," "when," "where," "who," and "how" of systematic literature reviews, the present paper applies the Scientific Procedures and Rationales for Systematic Literature Reviews (SPAR-4-SLR) protocol. The rationale for each of the aforementioned questions in relation to the present endeavor is synthesized in the table below (Table 1):

Building on this logic, the employment of SPAR-4-SLR protocol can be justified at multiple levels. First, it provides a rigorous and systematic approach to reviewing the existing body of literature on a specific research topic (Radianti et al., 2020). This method ensures that all relevant studies are identified, evaluated, and synthesized, leading to a comprehensive understanding of the research area. SPAR-4-SLR helps in minimizing biases by following a transparent and replicable process, which enhances the credibility and trustworthiness of the review findings. Second, by employing SPAR-4-SLR, researchers can make evidence-based decisions as it enables them to synthesize and analyze a large volume of research in a structured manner. This approach also facilitates the identification of research gaps and areas that require further investigation, thereby contributing to the advancement of knowledge in the field.

Since SPAR-4-SLR involves clear documentation of the search strategy, inclusion and exclusion criteria, and data extraction process, it promotes transparency and allows for the validation of the review process by other researchers. This enhances the overall reliability and validity of the review outcomes. In essence, SPAR-4-SLR adds rigor and quality to literature reviews by imposing a structured, transparent, and reproducible process that guides researchers through a logical and meticulous analysis of literature within the review domain (Paul and Criado, 2020; Paul et al., 2021).

The current undertaking applies the SPAR-4-SLR protocol which includes 3 stages, and 6 sub-stages as follows: *assembling* (*identification* and *acquisition* of literature that have not been synthesized), *arranging* (*organization* and *purification* of literature that are in the process of being synthesized) and *assessing* (*evaluation* and *reporting* of literature that have been synthesized) (Paul et al., 2021) (see Fig. 1).

In line with Bem De Bem Machado et al. (2022), the current paper employees a bibliometric analysis and systematic literature review to

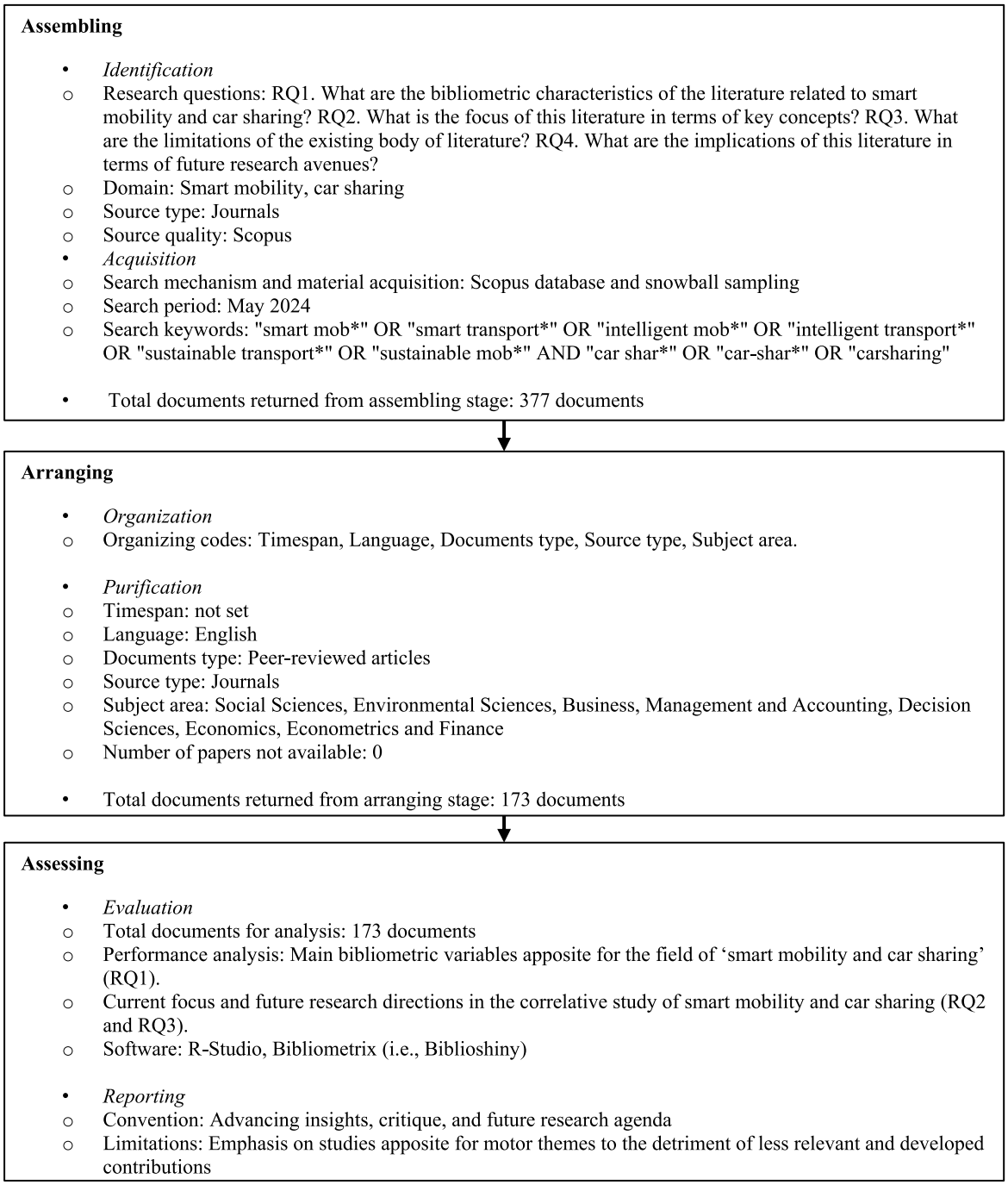


Fig. 1. The applied SPAR-4-SLR protocol.
Source: Authors' own processing

investigate the target research theme in a suitable manner. Pursuant to Zupic and Čater (2015), there are obvious benefits for using bibliometric research in the fields of business and management fields as this ensures objectivity standards for the process of evaluating scientific literature evaluation, thus strengthening the scrutiny's rigor, and mitigating the inherent biases. Additionally, as urged by Bem De Bem Machado et al. (2022), systematic literature reviews provide researchers with a fertile ground for capturing fresh streams of research, the opportunity of exploration being directly conducive to further enhancements of the field knowledge.

As mentioned in Table 1 (i.e., WHAT interrogation), consistent with Paul et al. (2021), a domain-based review concentrated on the topic of interest will be conducted via a bibliometric review underscoring statistics and trends in the review domain and a structured theme-based review of the extant body of work with a view to anticipating a future research agenda. Following the examples provided by the studies of Zupic and Čater (2015) and Bem Machado et al. (2022), four major research questions will be hereby envisaged, namely: RQ1. What are the bibliometric characteristics of the literature related to smart mobility and car sharing? RQ2. What is the focus of this literature in terms of key concepts? RQ3. What are the limitations of the existing body of literature? RQ4. What are the implications of this literature in terms of future research avenues?

Scopus database was considered as it is often used for systematic

literature reviews due to its extensive coverage and robust indexing practices. It is the world's largest database of peer-reviewed literature, covering over 22,000 journals, 150,000 books, and over 7 million conference papers across a variety of subject areas. This broad coverage ensures a comprehensive and diverse range of resources for a systematic literature review. Scopus also offers advanced search and filtering options, which allow researchers to efficiently navigate vast amounts of data and locate relevant studies (Quang et al., 2019). With its citation tracking feature, reviewers can assess the impact and relevance of each article, thus aiding the critical appraisal stage of the review process. Furthermore, due to its emphasis on quality, Scopus consistently indexes only credible and high-quality sources, ensuring the integrity and reliability of the systematic review.

The research strategy envisaged the inclusion of all the terms which have been used in the literature to capture the scope of smart mobility, that is, smart transportation, intelligent mobility, intelligent transportation, sustainable transportation, sustainable mobility. In order to avoid limiting the retrieved results, the research team resorted to Boolean operators using multiple keywords linked by OR and to truncation (to ensure that all written variations of the terms are included) (as recommended by Paul et al., 2021). The final keywords have been selected based on two grounds: 1. brainstorming among the members in the multidisciplinary research team, and 2. previous knowledge of the literature on the topic.

The research team used the following string to search the Scopus database: TITLE-ABS-KEY ("smart mob*" OR "smart transport*" OR "intelligent mob*" OR "intelligent transport*" OR "sustainable transport*" OR "sustainable mob*" AND "car shar*" OR "car-shar*" OR "carshar*"). Following this preliminary search, researchers then applied the predetermined inclusion and exclusion criteria in terms of timespan, language, documents type, source type, subject area. Only studies that meet the predefined criteria are included in the review (as explicitly illustrated in Fig. 1). The query for retrieving the final units of analysis is: TITLE-ABS-KEY ("smart mob*" OR "smart transport*" OR "intelligent mob*" OR "intelligent transport*" OR "sustainable transport*" OR "sustainable mob*" AND "car shar*" OR "car-shar*" OR "carshar*") AND (LIMIT-TO (SUBJAREA, "SOCI") OR LIMIT-TO (SUBJAREA, "ENVI") OR LIMIT-TO (SUBJAREA, "BUSI") OR LIMIT-TO (SUBJAREA, "ECON") OR LIMIT-TO (SUBJAREA, "DECI") AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "re") AND (LIMIT-TO (LANGUAGE, "English").

The records were extracted from Scopus and assessed via quality criteria. After looking into all the sources (i.e., abstract and introduction), the conclusion of their suitability for the scope of the study was drawn, therefore all 173 records were kept for further analysis. The next step was data extraction, where relevant information from each included study is systematically collected and recorded. To analyze the quantitative data, we used R studio and the Bibliometrix package of this software (Aria and Cuccurullo, 2017). Bibliometrix is a valuable tool for enhancing the review process in systematic literature reviews through its bibliometric analysis capabilities employed. It allowed for a comprehensive analysis of bibliographic data and visualization of information to assess the scientific body of knowledge on the given subject.

Biblioshiny is the web interface version of the R package Bibliometrix. The Bibliometrix R package and its Biblioshiny web interface facilitate quantitative research in scientometrics and bibliometrics by offering comprehensive tools to convert bibliographic data into interpretable information. Science mapping via Biblioshiny will ensure the analysis of the knowledge structures in terms of conceptual structure (i.e., what the envisaged articles tackle regarding themes and trends), intellectual structure (i.e., how authors' contributions in the field of interest impact a specific scientific domain or community) and social structure (i.e., how scholars, organizations and countries collaborate). Therefore, Biblioshiny allows users to perform several types of analyses, including collaboration networks, keyword analysis, trends over time, country, and affiliation-related analyses, etc. In terms of thematic mapping, Biblioshiny can help in identifying major themes by analyzing terms, keywords, and their co-occurrences within a set of documents. This can indicate which themes are prevalent and how they relate to each other (Aria and Cuccurullo, 2017; Cobo et al., 2011).

3. Results and discussion

This section is intended to explore the findings derived from the scrutiny of the body of literature under review, by answering the first three research inquiries on the main bibliometric information, topical insights, and critique regarding the correlative study of smart mobility and car sharing. By doing this, the current endeavor follows the recommendations of Massaro et al. (2016) who stress the importance of developing insights and critique through a thorough appraisal of the dataset.

3.1. The bibliometric characteristics of the investigated literature

Focusing on the first research question, emphasis will be placed on bibliometric data which links smart mobility and car sharing. The analytical framework will envisage the domain metrics and will consider the following variables: main information, authors (i.e., specifications: articles, citations, collaborations), sources (i.e., specifications: journals, citations), and keyword analysis (i.e., specification: occurrences).

3.1.1. Authors analysis

To start with, Table 2 illustrates a preview of the main information about the data extracted.

As seen in the table above, the articles are published in 77 different scientific sources. During the period of reference (i.e., 2002–2024), 173 documents were published in peer-review journals which met the inclusion criteria in the analyzed dataset, the annual growth rate being 7.59. The average citations number per document was 33.56. The retrieved articles include over 10000 references and over 1000 keywords plus, a fact which, pursuant to Secinaro and Calandra (2020), may be indicative of the manifold approaches of the subject matter and of its debatable nature.

Further, only 26 out of the 173 retrieved documents are single authored, therefore indicating that multiple-author contributions have been developed and the research theme claims for highly collaborative environments (please also note the value of the collaboration index which is 3.03). In terms of international co-authorship, it can be

Table 2
General information about records extracted.

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2002:2024
Sources (Journals)	77
Documents	173
Annual Growth Rate %	7.59
Document Average Age	5.09
Average citations per doc	33.56
References	10092
DOCUMENT CONTENTS	
Keywords Plus (ID)	1009
Author's Keywords (DE)	606
AUTHORS	
Authors	455
Authors of single-authored docs	26
AUTHORS COLLABORATION	
Single-authored docs	26
Co-Authors per Doc	3.03
International co-authorships %	30.64
DOCUMENT TYPES	
article	165
review	8

Source: Authors' own processing using Bibliometrix

observed that that a high proportion of the articles (i.e., 30.64%) are written by authors coming from different countries, consequently underscoring the wide scope of the research topic and its relevance at the international level.

Focusing on the yearly research publication/growth, the figure below presents the main trends regarding research interest on the subject matter. As seen in Fig. 2, the investigation of the dyad 'smart mobility – car sharing' reached a peak in 2021, with 28 articles published in peer-reviewed journals indexed in Scopus. A slight decline in number was observed in 2022 and 2023 whereas in the first months of 2024, 5 articles have been already published and indexed. In a snapshot, the scholarly interest in the envisaged topic started to grow incrementally since 2016, until then the growth rate being somehow modest. This may be mainly due to the topicality of the research theme which is often related to technological advancements in the mobility sector and has become a 'moving target' subject.

Going further, the authors' citations analysis provides additional bibliometric data and insights into the state-of-the-art. The average annual citations rate displays two peaks, a mean of 19 citations per document in 2010, respectively 14.3 citations per document in 2014 (see Fig. 3). After this year, the average citation rate per year decreased. Corroborating these figures with the ones presented before in terms of annual scientific production, things become clearer. The number of articles published on the topic before 2010 was quite low, therefore new contributions in the field highly cited the extant body of literature. Once the number of publications began to increase since 2016, the distribution was citations was spread among the higher number of publications, and the average rate of citations per document implicitly decreased.

Table 3 illustrates the ten most cited papers which were elaborated between 2010 and 2021. A deeper look into the approaches tackled by these articles is liable to provide pertinent insights into the theoretical and empirical issues deemed very relevant for the correlative study of smart mobility and car sharing.

As seen above, the most cited articles are published more than five years ago and form the foundation for the newly elaborated studies on the topic. The only exception is the research of the Diao et al. (2021) which systematically assesses the place occupied by transportation network companies (TNCs) in the context of the US urban transport system, paying heed to the evolving impacts of road congestion, transit ridership and private vehicle ownership over time. Their findings dare the relationship between large-scale car sharing and sustainable mobility and show how TNCs have progressively triggered new challenges in terms of urban transport.

Going further, Fig. 4 and Table 4 illustrate the geographical collaboration among the authors of the papers under lens.

As shown in Table 4, most of the authorship collaborations are developed between China and other countries from different continents and between UK and predominantly European countries. The top five geographical collaborations also cover the co-authorship between Canadian, German, and Italian scholars and researchers from other countries and continents. Only Italian collaborations are European-centric as observed in Table 4. The propensity for such geographical collaborations may have different justifications. On the one hand, in some countries (US, Canada), there is formal organizational support for developing international research partnerships. On the other hand, the empirical reality of car sharing, and smart mobility has reached a more advanced phase than in the emerging economies. Additionally, it is expected that countries with a geographical proximity and lower psychic distance to be focused on common research topics. Nevertheless, the authorship collaborations point to the scarcity of joint research between researchers in the less developed countries which may afflict the current knowledge on the state-of-the-art of smart mobility and car sharing dynamics in European countries such as Romania, Bulgaria, Hungary, etc.

Some relevant insights into the authors' analysis are provided by Lotka's law which depicts the frequency of publication by scholars in a defined field. Lotka's law stands as an approximate inverse-square law stating that the number of researchers publishing a specific number of papers represents a fixed ratio to the number of scholars authoring a single article. In accordance with Lotka's Law (as presented in Fig. 5 and Table 5), most of the authors (i.e., 87.7%) addressing the topic of smart mobility and car sharing are occasional, writing only one paper correlating these issues. Conversely, only a very low percentage of authors (i.e., 2.6%) have published at least 3 papers on the topic.

3.1.2. *Sources' analysis*

The present section explores the main sources addressing the subject matter and the specific of the international journals publishing contributions on this topic. As exhibited in Table 6, the highest number of articles on this topic (i.e., 22) comes from *Sustainability*, an open-access publication covering a broad spectrum of sustainability-related topics.

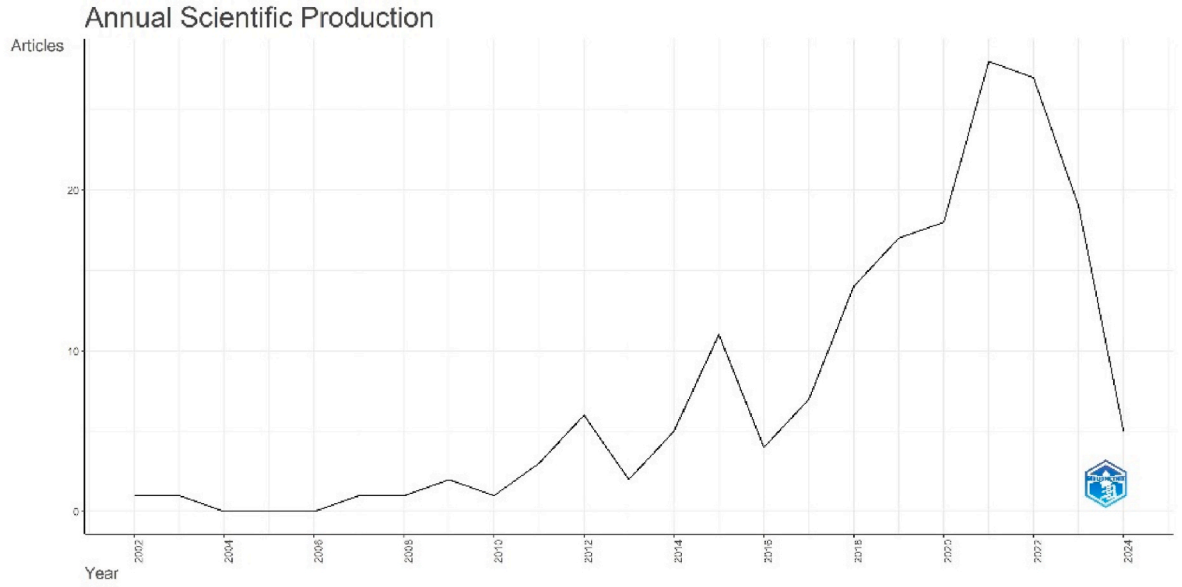


Fig. 2. Annual scientific production.
Source: Authors' own processing using Bibliometrix

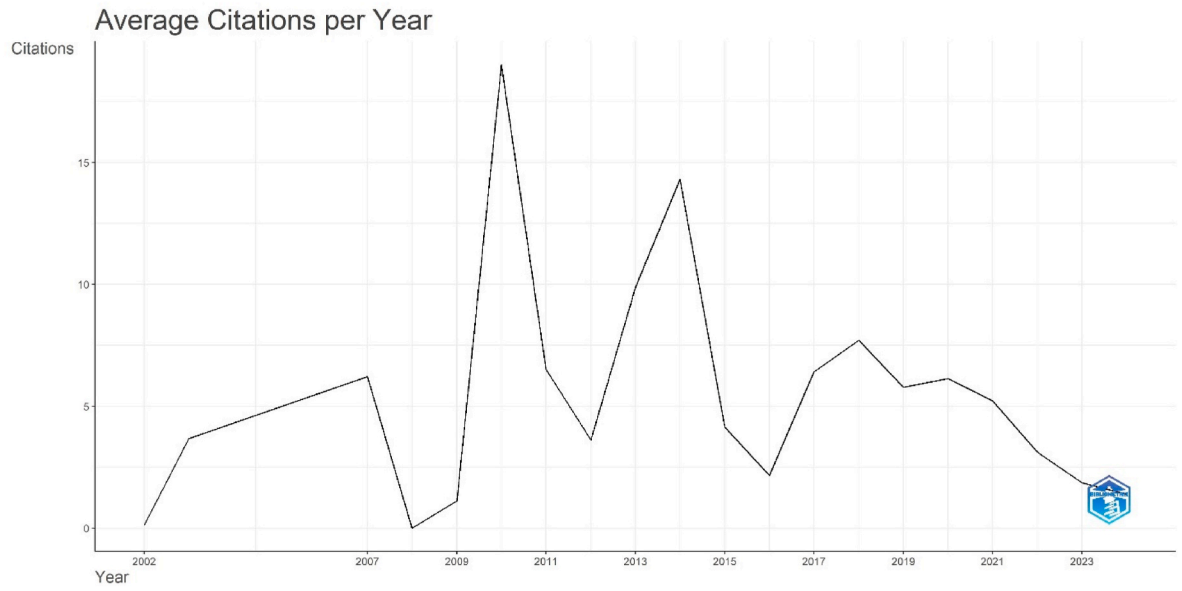


Fig. 3. Average citations per Year.
Source: Authors' own processing using Bibliometrix

Table 3
Most global cited documents.

Paper	DOI	Total Citations	TC per Year
Cohen and and Kietzmann (2014)	10.1177/1086026614546199	679	61.73
Santos et al. (2010)	10.1016/j.retrec.2010.03.002	285	19.00
Awasthi et al. (2018)	10.1016/j.envsoft.2010.11.010	188	13.43
Shaheen et al. (2012)	10.1016/j.rtbm.2012.04.005	171	13.15
Javid and Nejat (2017)	10.1016/j.tranpol.2016.11.003	158	19.75
Santos et al. (2013)	10.1016/j.jtrangeo.2013.04.005	128	10.67
Kim et al. (2015)	10.1016/j.trd.2015.02.009	128	12.80
Mugion et al. (2018)	10.1016/j.jclepro.2017.11.052	125	17.86
Diao et al. (2021)	10.1038/s41893-020-00678-z	122	30.50
Pakusch et al. (2018)	10.3390/su10072404	120	17.14

Source: Authors' own processing using Bibliometrix

The second outlet in terms of the number of articles published (i.e., 12) – *Journal of Cleaner Production* - is a premier international, transdisciplinary journal in the generic field of sustainability research and practice, explicitly aiming at supporting societies to embrace a more sustainable-centric approach. The top ten sources based on the number of published articles on the topic continues with more focused titles on the transportation area of interest, that is *Transportation Research Part D: Transport and Environment Transport Policy, Transportation Research Part A: Policy and Practice, International Journal of Sustainable Transportation*, etc. A compelling insight which may be drawn from these facts and figures is that the correlative study of smart mobility and car sharing has substantively caught the attention of transdisciplinary journals, thus proving its relevance from socio-economic and technological perspectives rather than transport-centric angles.

By performing source clustering via Bradford's law, new insights emerge. Pursuant with this law, when sources are organized in the descending order of the number of articles published on the target topic, successive zones of journals covering the same number of specialized papers will form a simple geometric series. In this sense, the first zone mentioned in Table 7 and Fig. 6 stands for the nucleus of sources which are devoted to the specific topic.

As it may be seen in the table and figure above, five journals (*Sustainability, Journal of Cleaner Production, Transportation Research Part D: Transport and Environment, Transport Policy, Transportation Research Part A: Policy and Practice*) are situated in the core zone, publishing 37% of the articles dedicated to the subject matter. As previously pinpointed, the first two journals are transdisciplinary, thus confirming the wider relevance of the envisaged topic at the societal level.

Fig. 7 exibits the sources' production over time. As can be seen, the first article in Zone 1 was published in 2012 in Transport Policy. Starting with 2016, respectively, 2018, articles specialized in the correlative study of smart mobility and car sharing have been published in international and transdisciplinary journals such as *Journal of Cleaner Production* and *Sustainability*. The ascendent trend in scientific publications in the Zone 1 outlets indicates that the target research theme is catching more and more scholarly attention, and it is considered of interest by the wider scientific community, thus beyond the transport-driven research.

3.1.3. Keywords' analysis

Going further with the keyword analysis, the inherent procedure relies on their co-occurrence in the retrieved articles' titles, abstracts, and keywords. As illustrated in Fig. 8, the most prominent growth occurred for terms such as *sustainability, sustainable development, car use, car sharing* and *sustainable mobility*. The fact that only two of the five mentioned keywords were part of the initial search string confirms once again the noteworthiness of the topic from the standpoint of 'higher order' frameworks such as sustainability and sustainable development.

3.2. Thematic mapping

The conceptual structure returned by the thematic map output organizes the articles under review into the four thematic areas with different clusters of interest according to Noyons (2001). Consequently, the following section of the paper will fathom the research nodes indicative of the correlative study of smart mobility and car sharing by giving credit to the emerging/declining, niche, motor, and basic themes derived from the thematic map. In this way, the argumentative endeavor will give way to the second and third research questions (RQ2: What is the focus of this literature in terms of key concepts? and RQ3. What are

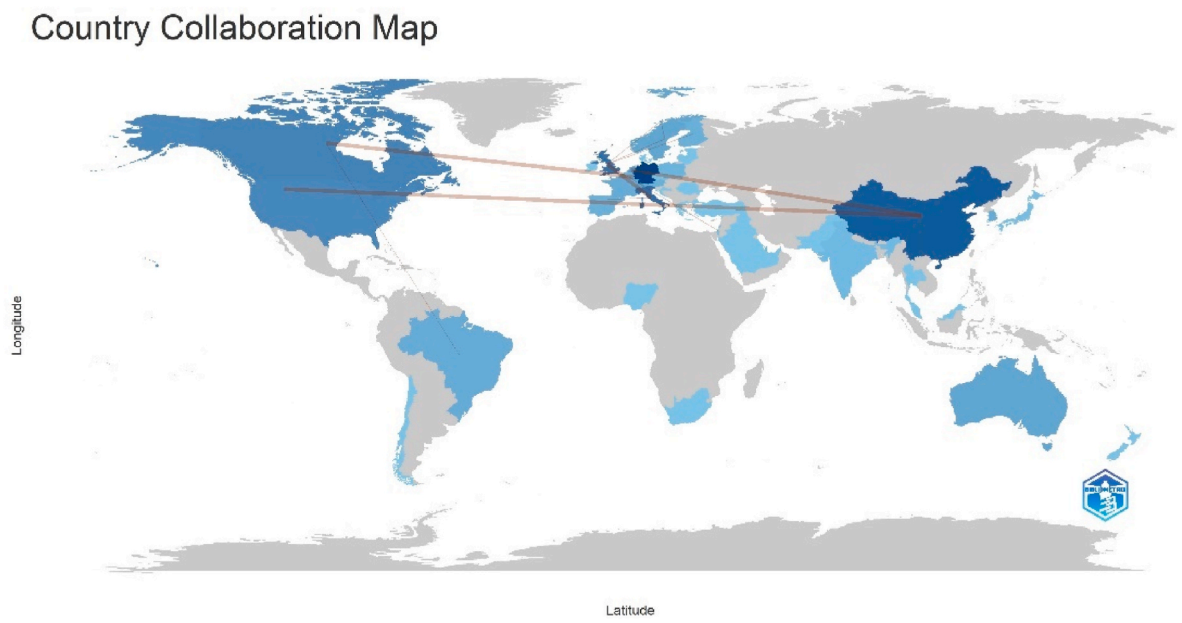


Fig. 4. Collaboration world map.
Source: Authors' own processing using Bibliometrix

Table 4
Most important collaborations among international researchers.

From	To	Frequency
China	Netherlands, USA, Singapore, Belgium, Czech Republic, Korea, Pakistan, Saudi Arabia, United Arab Emirates	14
United Kingdom	Finland, Israel, Norway, Sweden, Canada, Malta, Netherlands, Portugal, Switzerland, USA	14
Canada	Luxembourg, Brazil, Australia, Chile, France, New Zealand, Switzerland	10
Germany	Switzerland, Australia, Austria, Belgium, Canada, Netherlands, Spain, Sweden, United Kingdom	10
Italy	United Kingdom, France, Luxembourg, Malta, Portugal, Romania, Sweden	10

Source: Authors' own processing using Bibliometrix

the limitations of the existing body of literature?) and will advance preliminary answers to the fourth research question (RQ4. What are the implications of this literature in terms of future research avenues?).

As previously mentioned, a compelling research insight is provided by the thematic map displayed in Fig. 9 and by the keywords co-occurrences according to clusters and themes in Table 8. By applying a clustering algorithm on the keyword network, it becomes possible to underline the various themes covered by a given domain. Hence, the thematic map is descriptive of how the pivotal research themes in the field have evolved over time, setting two main parameters, consistent with Noyons (2001): density (i.e., development degree) and centrality (i.e., relevance degree). Each bubble depicts a network cluster while the names on the bubble stand for the high occurrence terms within the cluster. There is a direct proportional rapport between the bubble size and the cluster word occurrences. There are ten different clusters organized in relation to the fourth quadrants in the map as shown below.

The map shows four thematic areas which consist of various clusters (Cobo et al., 2011). For instance, the first quadrant – top right side – depicts the motor themes which have a high document density and relevance within the dataset. These themes in this quadrant are both frequent and closely related to the general content of the literature, being the most prominent and significant within the dataset. The motor themes encompass three main clusters, that is, smart mobility, multimodality, and smartphone (grey cluster), car sharing, sharing economy and urban mobility (red cluster) and sustainable transportation, electric vehicles, and flee-floating car sharing (pink cluster).

The upper left quadrant encompasses themes that have high document density but low relevance to the overall content, thus standing out as highly developed, but isolated themes. These niche themes appear frequently in the literature but may not directly align with the main research objective or key concepts of interest. Subsequently, the clusters included in this zone cover issues such as electric vehicles, feature importance and machine learning (blue cluster) and climate change, travel demand management and urban transportation (light brown cluster).

Next, the lower right part of map exhibits the basic or transversal research themes apposite for the correlative study of smart mobility and car sharing. They have a high level of relevance, yet a low density and this covers car sharing, shared mobility, and sustainable mobility (light green cluster), sustainable transport, car ownership, and collaborative consumption (dark green cluster) and car sharing, sustainability, and mobility (orange cluster).

The lower left quadrant of the map is indicative of low relevance and low density, pointing to emerging or declining themes. These themes have a limited presence in literature and are not closely related to the main research topics. They may represent outliers, noise or minor concepts that are not essential to the dataset. Here, two different clusters are under scrutiny, i.e., automotive industry and sustainable urban mobility (purple cluster) and transport policy and travel behavior (blue cluster).

Based on the thematic map distribution (i.e., emerging/declining, niche, motor, and basic themes) and on the statistical techniques employed by Biblioshiny which automatically assigns articles per the identified clusters (described in Table 8), the following sub-sections will delve into the scope of the most relevant topics corresponding to the study of smart mobility and car sharing. The topics were named and grouped based on: 1. their position on the thematic map, 2. their scope within the analyzed literature, 3. the main keywords encompassed which are indicative of the research focus of the studies in a particular cluster. Consequently, the main clusters in the motor theme quadrant (i.e., high density and high centrality) were scrutinized independently while less developed or less relevant clusters were grouped based on keyword similarity and thematic overlapping.

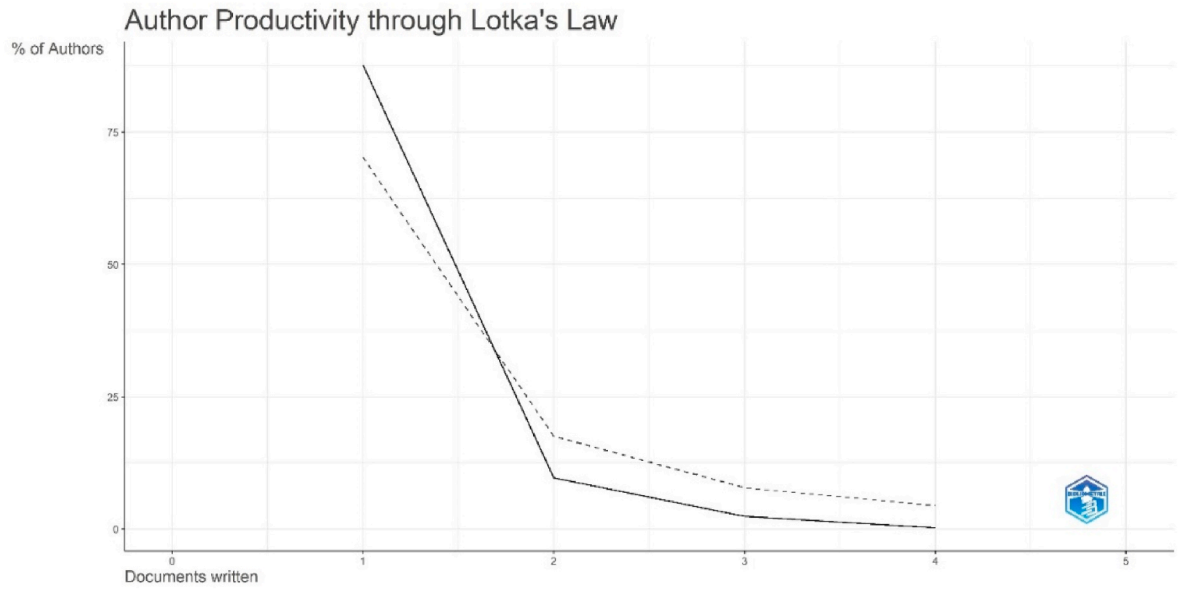


Fig. 5. Lotka's Law in terms of author productivity.
Source: Authors' own processing using Bibliometrix

Table 5
Calculations for the Lotks's law.

Documents written	N. of Authors	Proportion of Authors
1	399	0.877
2	44	0.097
3	11	0.024
4	1	0.002

Source: Authors' own processing using Bibliometrix

Table 6
Most relevant sources.

Sources	Articles
Sustainability (Switzerland)	22
Journal of Cleaner Production	12
Transportation Research Part D: Transport and Environment	12
Transport Policy	9
Transportation Research Part A: Policy and Practice	8
International Journal of Sustainable Transportation	6
Transportation	6
International Journal of Automotive Technology and Management	4
Journal of Advanced Transportation	4
Journal of Transport Geography	4

Source: Authors' own processing using Bibliometrix

Table 7
Source clustering through Bradford's Law.

Sources number	Articles published	% of the total articles published	Zone
5	63	0.37	Zone 1
17	54	0.31	Zone 2
55	56	0.32	Zone 3

Source: Authors' own processing using Bibliometrix

3.2.1. Topic 1: car sharing through the lens of urban mobility management, innovative business models and governance

The first topic of interest which emerged as a motor theme brings together the issues of car sharing, mobility management in urban areas, innovative business models and governance policies. The articles comprised by this cluster collectively explore various aspects of sustainable (urban) mobility and car sharing, emphasizing the importance of different models, methodologies, and stakeholder dynamics, especially through the lens of business models and governance implications. They point to the complexities and opportunities within the realm of sustainable mobility, emphasizing the need for innovative approaches, stakeholder alignment, and supportive regulatory frameworks to advance car sharing and other shared mobility solutions.

Relying on a transport-centric standpoint, Awasthi and Chauhan (2011) introduce a hybrid approach combining the Analytical Hierarchy Process (AHP) and Dempster-Shafer theory to assess the sustainability impact of various eco-friendly transport measures, such as mode sharing and intelligent transport solutions whereas Duncan (2011) explores car sharing as a service for occasional private transportation needs, highlighting its potential to enhance a diversified and sustainable transport system in an effort to quantify the cost savings associated with car sharing. Going further, Juschten et al. (2019) identify potential markets for car sharing in Swiss conurbations using GIS mapping tools. Their results suggest that transportation policies, such as mobility pricing, positively influence car sharing membership. Nevertheless, the study expands its economic implications by concluding that car sharing is not just an economic choice but also a lifestyle decision aimed at reconfiguring infrastructure intricacies.

Another research node under the first topic lays emphasis on the socio-demographic factors associated with car sharing dynamics. To start with, Alonso-Almeida (2019) conducts a survey of over 200 women to understand their use of car clubs and peer-to-peer car sharing. Findings indicate that women engage in car sharing when they perceive business and personal value. However, there are notable differences in perceptions of car club and peer-to-peer car sharing, with implications for management, policy, and efforts to bridge gender gaps in transportation. Similar studies are conducted by Mavlutova et al. (2021) and Kubera and Ślusarczyk (2023). The former investigate car sharing in Latvia, identifying motivational factors and generational differences that influence user preferences, subsequently supporting the development of new car sharing business models and policy recommendations for sustainable transport promotion. The latter characterize car sharing users in Poland, finding that they demonstrate sustainable transport behaviors, such as increased walking and cycling and reduced private car use. The study also identifies working people and students as primary car sharing users.

The investigation performed by Jain et al. (2021) looks into the

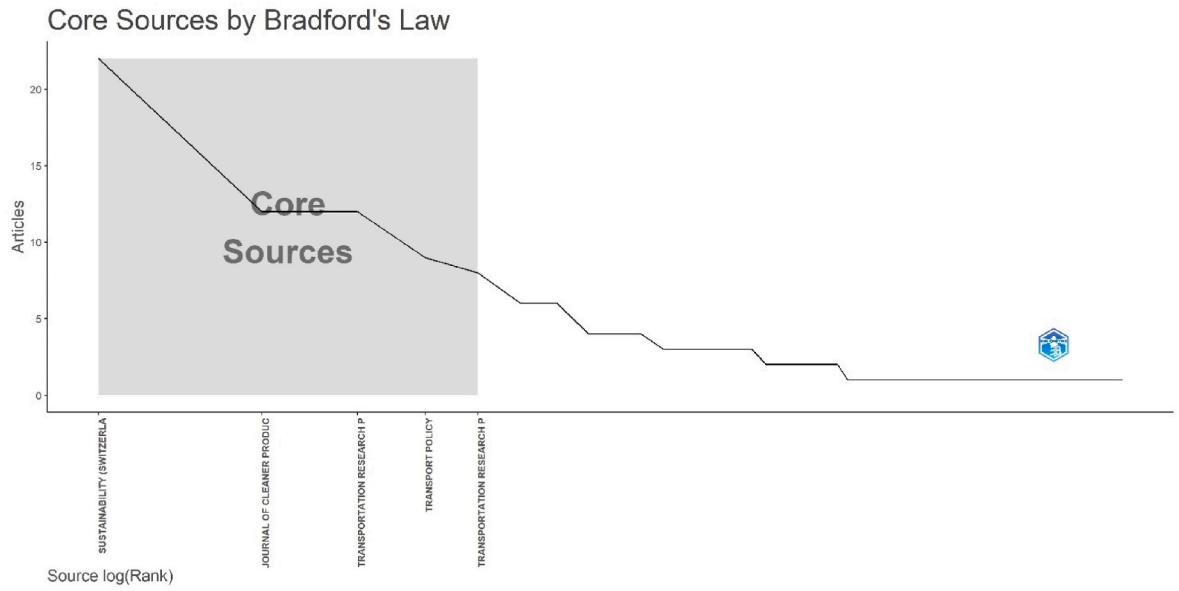


Fig. 6. Core sources clustering based on Bradford's Law.
Source: Authors' own processing using Bibliometrix

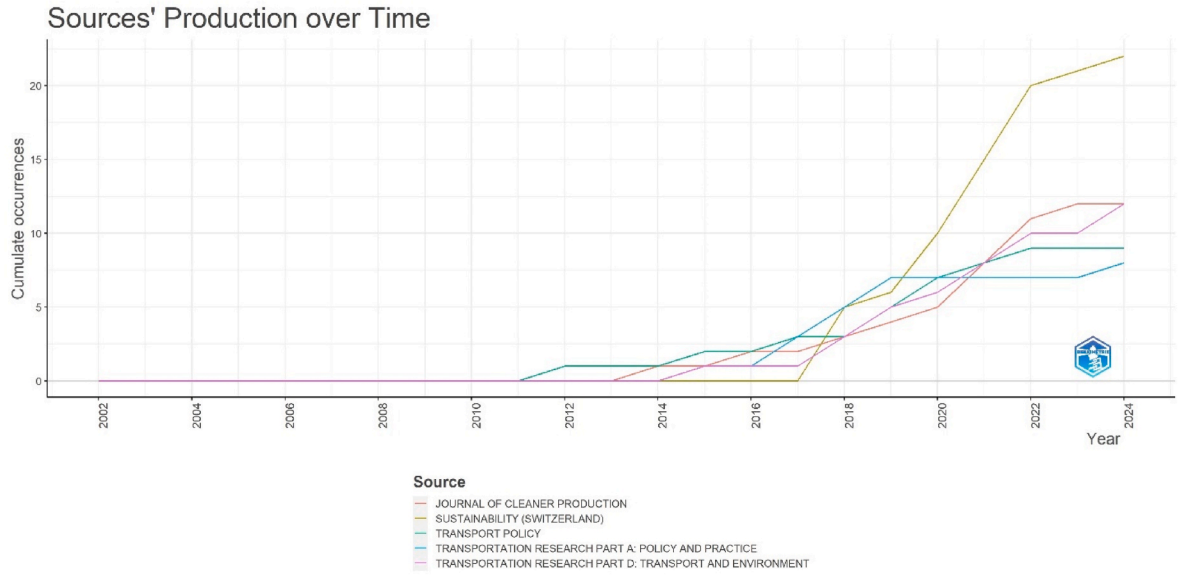


Fig. 7. Sources' production over time.
Source: Authors' own processing using Bibliometrix

psychosocial determinants of car sharing adoption, identifying barriers and motivators such as cost, convenience, environmental concerns, community sharing, and normative beliefs about car ownership, offering insights for car sharing operators and policymakers to address adoption barriers. When exploring the residents' preferences for car sharing-facilitating neighborhoods in the Netherlands. Wang et al. (2021a,b) found that preferences depend on car sharing costs, booking time, green space, housing costs, and sociodemographic characteristics. In a more extensive empirical framework, Aguilera-García et al. (2022) examine the sociodemographic and psychological factors affecting car sharing usage in Europe. They find that free-floating car sharing is more popular among young, wealthy, well-educated males living in dense urban areas. The study strives to assist policy implications for understanding car sharing's impact on travel behavior and sustainability. Conversely, by assuming a broader conceptual reference, Hartl and Hofmann (2022) study the social dilemma of car sharing communities, finding that power mechanisms, such as sanctions, and trust mechanisms, influence contributions to shared cars and providing insights for the sharing economy and the formation of sharing communities.

Revolving around (innovative) business models, Cohen and Kietzmann (2014) analyze shared mobility business models using agency theory to identify the best relationship between service providers and local governments for achieving sustainable mobility. They find that both private and public models have inherent conflicts and suggest a merit model as the most effective alignment of interests. To design operating areas for car sharing providers, Seign et al. (2015) develop a model to predict successful business areas for free-floating car sharing systems based on population density, housing rent, city center distance, and hotel/restaurant density. Perboli et al. (2018) go further and provide a comprehensive analysis of car sharing services from a business

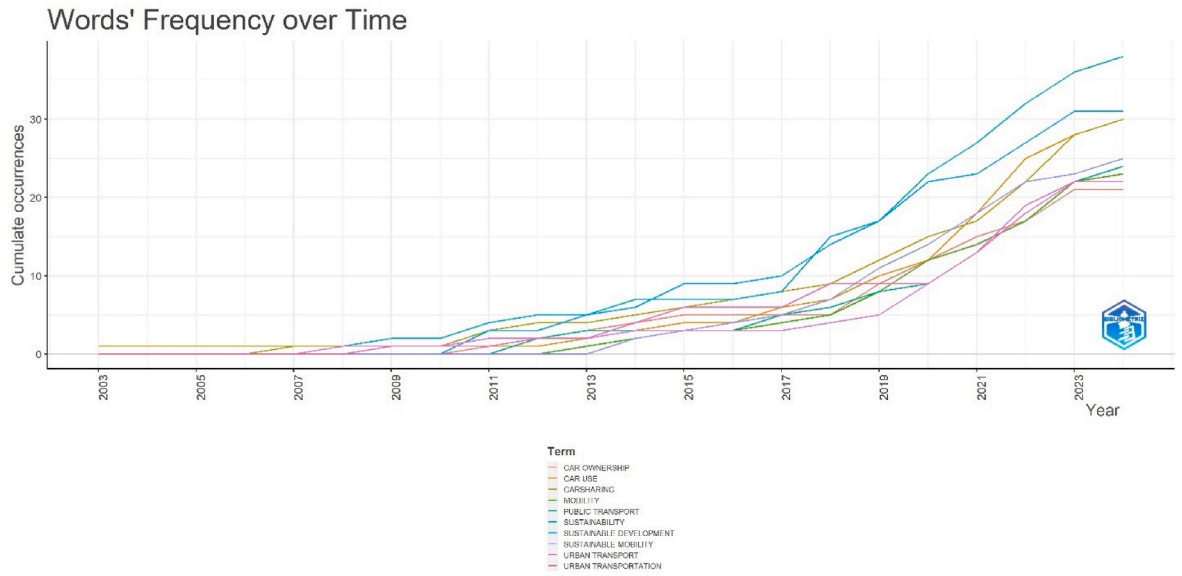


Fig. 8. Keyword frequency increase over time.
Source: Authors' own processing using Bibliometrix

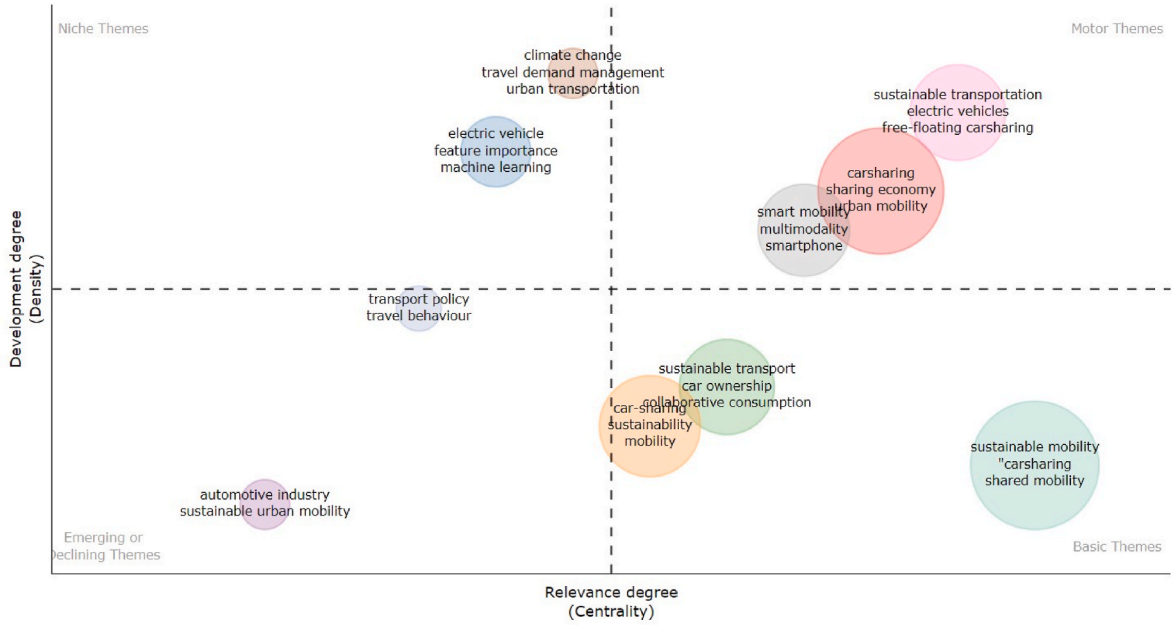


Fig. 9. Thematic map.
Source: Authors' own processing using Bibliometrix

model perspective. They introduce a reproducible method to compare different car sharing companies and emphasize the importance of creating customized tariff plans to meet diverse user needs.

In a more comprehensive study, Münzel et al. (2020) analyze shared car availability in 177 cities across five Western European countries, distinguishing between traditional business-to-consumer (B2C) and peer-to-peer (P2P) models. They find that car sharing thrives in cities with high educational levels or university presence and, for B2C models, where there are many green party votes. Conversely, cities with numerous car commuters see less car sharing uptake. The study highlights country-specific differences: P2P car sharing is notably popular in French cities, whereas B2C car sharing is more prevalent in Germany.

Still focusing on the business-centric peculiarities, Turoń (2022) analyzes the business models of shared mobility systems using the CANVAS model, assessing their readiness for open innovations. The study finds that car sharing service providers are the most resistant to open innovation, whereas bike-sharing services are the most open. Torrisi et al. (2022) provide insights into improving transport supply and implementing co-creation actions between service companies and end-users in urban contexts. In this sense, Ortega et al. (2023) identify key trends and challenges in European car sharing research, emphasizing the importance of coordinated implementation with public transport and monitoring to ensure environmental benefits.

At the crossroads of new business approaches and governance policies, Bocken et al. (2020) apply the "ecologies of business models" perspective to car sharing in four Swedish cities, finding that car sharing complements rather than replaces private car usage. They suggest pathways for local policymakers to implement sustainable car sharing

Table 8
Keyword grouping according to clusters and themes.

Thematic areas	Cluster label in the map	Main recurrent keywords in the cluster
Motor themes (top right quadrant)	Car sharing	car sharing, sharing economy, urban mobility, travel behavior, mobility management, business models, governance, business-to-consumer, fleet management, innovation adoption, local government, peer-to-peer policy, ridesharing, sustainable development, sustainable transport systems, urban sustainability
	Sustainable transportation	sustainable transportation, electric vehicles, free-floating car sharing, e-car sharing, electric car sharing, battery electric vehicles, energy consumption, mobility behavior, user-based relocation
	Smart mobility	smart mobility, multimodality, smartphone, bike-sharing, carpooling, integer linear programming, parking slot renting, ride-hailing
Niche themes (top left quadrant)	Electric vehicle	electric vehicle, feature importance, machine learning, trip distance
	Climate change	climate change, travel demand management, urban transportation
Basic or transversal themes (right lower quadrant)	Sustainable mobility	sustainable mobility, car sharing, shared mobility, public transport, urban transport, environmental sustainability, mobility patterns, mobility as a service, mobility transition optimization, system dynamics, transport governance, willingness-to-pay
	Sustainable transport	sustainable transport, car ownership, collaborative consumption, discrete choice model, electric car, free-floating car sharing, theory of planned behavior, travel mode choice
	Car sharing	car sharing, sustainability, mobility, analytical hierarchy process case study, environment, environmental impacts assessment, satisfaction, vehicle relocation
Declining or emerging themes (left lower quadrant)	Automotive industry	automotive industry, sustainable urban mobility
	Transport policy	transport policy, travel behavior, transport sector

Source: Authors' own processing using Bibliometrix

solutions, emphasizing the role of local governments in the co-evolution of car sharing initiatives within broader sustainability and mobility trends. Additionally, Moscholidou and Pangbourne (2020) use London and Seattle as case studies to explore the regulation of smart mobility providers and their accountability for urban environmental impacts. They conclude that regulation is a pivotal but not sole element of smart mobility governance, underscoring the need for comprehensive strategies to achieve sustainable transport futures.

The scrutiny of Peltomaa and Tuominen (2022) further analyzes the collaboration between car sharing operators and public authorities in Finland, highlighting the importance of local authorities in ensuring the environmental and social sustainability of shared mobility services. Drobiazgiewicz and Pokorska (2023) provide an in-depth analysis of car sharing trends and their implications for reducing private car use in urban areas, contributing to the broader discussion on sustainable urban transportation while Eliyan and Kerbache (2024) review the vehicle imbalance problem in one-way car sharing and propose solution algorithms to ensure balanced vehicle distribution, enhancing the sustainability of car sharing services.

Giving way to regulations and governance approaches, Awasthi et al. (2018) discuss the challenges cities face in implementing sustainable mobility measures, such as public transport and energy-efficient vehicles, due to the lack of quantitative data and varying local conditions. They apply multicriteria decision making (MCDM) techniques to evaluate urban mobility projects under uncertainty, marking a pioneering effort in this area. Akyelken et al. (2018) examine the regulatory challenges in promoting low-carbon practices like car sharing. They argue that existing governance structures may be inadequate and highlight the need for new governance approaches that consider the diverse incentives of all stakeholders in the sharing economy. Their qualitative study of car sharing in London reveals the dynamic interplay of ideas, incentives, and institutions in the emerging sharing economy. Furthermore, Münzel et al. (2019) emphasize the role of car sharing in transitioning to a sustainable mobility system by altering car usage patterns and transportation needs. They advocate for regulatory frameworks that support a multi-modal transportation system rather than focusing on specific car sharing models. Here, Zhu et al. (2023) review shared mobility's role in sustainable transportation, highlighting its benefits and the regulatory roles of government policies in promoting sustainable urban transport systems.

3.2.1.1. Joint contribution and limitations of the studies dedicated to urban mobility management, innovative business models and governance. From a bird's eye view, the topic covering car sharing issues through the lens of urban mobility management, innovative business models and governance brings forward compelling insights in terms of theoretical, methodological, and empirical implications.

Firstly, mobility management, innovative business models and governance dynamics are treated both independently and correlatively, thus advancing integrative perspectives of the subject matter. As previously exemplified, there is a wealth of studies tackling the intersection of business models and governance structures and policies, of business models and innovation adoption, of consumers' socio-demographic characteristics and mobility management. The ambivalence and/or multivalence of such discussions manages to round off the analytical frameworks and emerge as building blocks for decision-making and policymaking.

Secondly, the methodological designs of these studies are quite diverse, succeeding in complementing one another and strengthening the validity of the drawn conclusions. The studies employ quantitative, qualitative, and mixed research methods, displaying a wide range of techniques, tools, and procedures (i.e., questionnaire and interview-based surveys, experiments; case studies; Analytical Hierarchy Process (AHP) and Dempster-Shafer theory; multicriteria decision making (MCDM) techniques, namely fuzzy TOPSIS, fuzzy VIKOR, and fuzzy GRA; Monte Carlo simulations, secondary data analysis, CANVAS models, Generalized Structural Equation Model (GSEM), agent-based simulation of a case study, etc.).

Thirdly, the scope of the empirical units of analysis is also broad, covering studies from over 10 countries (e.g., Australia, Belgium, Czech Republic, France, Germany, Italy, Latvia, Poland, Sweden, Switzerland, The Netherlands, UK, US). Despite the high number of national contexts, the issues of urban mobility management, innovative business models and governance are mostly European and US-centric and one-sided as very few contributions capture international comparisons among different countries. This situation demands more scientific propensity towards international co-authorship and transnational data collection with a view to pertinently spotting the explicit and underlying differences and variations across countries.

In terms of theoretical and practical implications, the examined studies have brought forward some limitations of the extant body of knowledge as follows:

1. Research has predominantly relied on small-scale surveys limited to specific cities or organizations, focusing mainly on traditional B2C car sharing. This neglects the rise of P2P car sharing through online platforms.
2. The integration of urban planning with car sharing has remained largely informal and undocumented, despite its critical role in the success of car sharing.
3. There is a significant gap in understanding the psychosocial aspects influencing car sharing adoption and smart mobility. Knowledge of the motivators and barriers to carshare adoption is vital for policy development but has been insufficiently explored.
4. Recent trends indicate a shift towards greener consumption patterns, yet a low proportion of consumers prioritize sustainability.
5. Car sharing within communities still poses a social dilemma where individualistic interests conflict with collective benefits, requiring fair contribution and usage from all members.
6. Despite the potential of vehicle-to-grid car sharing, customer interest in this area remains unexplored.
7. The transportation sector has been slow to transition from oil dependency despite its significant contribution to greenhouse gas emissions. Sustainable mobility solutions, such as autonomous car sharing services and innovative alternatives like shared autonomous cargo bike fleets are yet to be fully developed.
8. Though effective transition to sustainable mobility necessitates strong collaboration between private companies and public authorities, particularly at the local level, insufficient attention has been paid to the role of practical actors, such as car sharing operators, which is critical for successful collaboration and service sustainability.
9. The concept of *car sharing-facilitating neighborhoods*, integrating car sharing with sustainable transportation and residential planning, is new and lacks sufficient data on residents' responses.

3.2.2. Topic 2: Sustainable transportation and e-car sharing

The second topic of interest mainly addresses the relationship between sustainable transportation and e-car sharing, namely the opportunity to use electric vehicles with a view to improve the economic, societal, and environmental impact. In this vein, achieving energy reduction in urban mobility stands out as an imperative as urged by Scarinci et al. (2017). Their study assesses the feasibility of the 2000-W society's energy consumption goals through various transportation policies, concluding that a combination of reduced car usage, increased walking and cycling, and decreased travel distances is necessary to achieve significant energy reductions. Some investigations go deeper into the **impact of free-floating car sharing on private car ownership. For example,** Le Vine and Polak (2019) examine the early-stage effects of free-floating car sharing on private car ownership, indicating the quite specific user profile of CS adopters – i.e., higher income and education levels among users compared to the general population. **Focusing on the user-based relocation in electric car sharing,** Wang et al. (2021) develop a user-based relocation model to address supply-demand imbalances in EC operations. Their analysis reveals that a combination of preferential pricing and fines can enhance system profitability and reduce failure rates, promoting sustainable EC operations.

When it comes to the success factors in electric car sharing, Degirmenci et al. (2017) delve into the critical success factors for car sharing services through expert interviews to enhance the sustainability and adoption of electric car sharing services. At this level, Hinkeldein et al. (2015) have previously addressed **user requirements for integrated electric vehicle and public transport services** emphasizing the importance of attitude-based market segmentation for successful e-mobility services integration. Their literature analysis suggests targeting specific user attitudes and requirements to enhance service adoption. In a more contextual analytical framework, Tran et al. (2019) investigate the public acceptance of electric car sharing (EC) systems in developing countries, i.e., China. They find that hedonic motivation significantly influences the intention to use EC services, alongside performance expectancy, effort expectancy, and familiarity with car sharing. Gender and age moderate these effects, providing insights for successful EC implementation.

Shifting the attention to the **adoption of plug-in electric vehicles (PEVs),** Javid and Nejat (2017) explore factors influencing PEV adoption across 58 California counties. Their model identifies that household income, education level, car sharing status, charging station density, and regional gas prices significantly affect PEV adoption. The advanced methodology is prone to inform sustainable transportation policies and optimize infrastructural investments, benefiting sectors like electricity, gasoline/diesel retailing, and automotive manufacturing. Going further, Meisel and Merfeld (2018) explore **the economic incentives for electric vehicle services** and propose economic incentives for EV services through microgrid operation, energy trading, and vehicle sharing. Their classification of service types aims to maximize the economic potential of EVs, guiding policy measures to support EV adoption.

Some studies in this cluster propose a more technical-driven approach on the relationship between sustainable transportation and e-car sharing, shedding light on the battery specifications and charging operations. To start with, Brendel et al. (2018) approach the **battery electric vehicle utilization management system (BEVUMS)** and recommends its utility to optimize the use of electric vehicles in mixed fleets. Their findings indicate that BEVUMS can prevent charging-related issues, increase BEV rental ratios, and extend rental periods, contributing to improved BEV utilization and battery longevity. Such a framework offers a benchmark for future research and potential sustainability benefits. Ruhrort et al. (2014) explore the suitability of BEVs for car sharing and identify target groups for integrated mobility systems. Their findings from the 'BeMobility - Berlin elektromobil' project highlight user satisfaction with e-car sharing and the importance of attitude profiles and mobility needs for service success. Furthermore, Lo et al. (2022) address the issue of smart charging for electric car sharing (ECS) and propose a smart charging method to optimize ECS fleet management. Their approach aims to support ECS operators by efficiently utilizing charging points, addressing the complexity of managing EVs compared to traditional vehicles.

3.2.2.1. Joint contribution and limitations of the studies dedicated sustainable transportation and e-car sharing. Similarly to the situation of the previously analyzed cluster, the topic covering the issues of sustainable transportation and e-car sharing advances some noteworthy insights in terms of theoretical, methodological, and empirical implications.

On the one hand, the topic is addressed by means of various angles ranging from the psychosocial factors descriptive of ECS adoption toward the technical specifications of the new mobility services. The analysis also looks into the aggregate effects of ECS adoption in terms of social, economic and technological layers, thus ensuring a comprehensive perspective of the state-of-the-art. On the other hand, the variety and complexity of the research designs applied by the studies (i.e., quantitative, qualitative, and mixed methods based on a wide range of research techniques and procedures such as structural equation modeling, multiple logistic regression analysis, negative binomial regression models, multivariate analysis, sensitivity analysis, multiple case studies comparison, mode shift scenarios, etc.) are conducive to complementary and reinforcing insights for a in-depth discussion of the topic.

The scope of the studies in terms of country is still quite broad. The correlation between sustainable transportation and e-car sharing is addressed in both developed and emerging countries, investigations on the topic have been conducted in Austria, Canada, China, France, Germany, Portugal, US. Though the coverage of the topic is wide, the state-of-the-art in the case of European developing countries is in an embryonic stage and requires future scrutiny. Moreover, the comparation-

based examinations are still scant, very few endeavors in the field displaying an international focus.

In terms of theoretical and practical implications, the studies clustered under this topic have brought forward some limitations of the extant body of knowledge as follows:

1. The evidence base for free-floating car sharing's impact on sustainable transport indicators is underdeveloped. This gap is significant, especially given the role of public policy in promoting this car sharing model.
2. In terms of electric vehicle adoption, policymakers often use subsidies and non-economic incentives to encourage electric vehicle (EV) adoption. Yet, consumer concerns about the economic benefits of EV ownership remain a significant barrier to widespread adoption.
3. The attitude-based approaches can enhance the development of integrated mobility services by targeting specific groups. Various methods use different metrics to gauge mobility-related attitudes, aiming to create tailored services, yet insights for policy and intervention development to support new mobility services are still incipient.
4. Electric car sharing faces profitability and management challenges. Addressing supply-demand imbalances through vehicle relocation emerges as essential, with user-based relocation proving to be more sustainable and cost-efficient than operator-based methods.
5. In terms of usage patterns and environmental impacts, research has primarily focused on Asia, North America, and metropolitan areas. Most studies have analyzed the relationship between car sharing and public transport, leaving a scarcity of research on the usage of other shared mobility services.

3.2.3. Topic 3: Smart mobility and multimodality

The third research topic which rises as a motor theme envisaged the relationship between smart mobility and multimodality. This gives way to a complementary approach to the previously discussed topic, shifting the attention to the technological advancements conducive to the success of smart mobility. The rapid development of modern information and communication technologies, especially the Internet and mobile phones, has significantly impacted the mobility sector, consequently, policies and processes for sustainable mobility increasingly rely on these technologies.

Studies are mainly concentrated on the dynamic transition to a multimodal society, also acknowledging the role of smartphones and apps in mobility. In this vein, Groth (2019) contributes significantly to the discourse on transitioning from an automobile-centric society to a multimodal one. This transition, characterized by the flexible use of various transport options, is driven by the advent of smart mobility technologies like smartphones. The study highlights challenges such as transport poverty, which limits multimodal behavior, and a multimodal divide, where access to smart mobility is hindered by the lack of necessary ICTs among socially marginalized groups. Similarly, Al-Addal (2021) investigates the frequency of smartphone use in accessing car sharing services, pinpointing that simplifying smartphone access can expand car sharing use, complementing mass transit, and providing additional mobility options. Schwanen (2015) examines the pivotal role of smartphones and mobile apps in recent urban mobility innovations, including car sharing and real-time public transport information and signals the gap in understanding how these apps influence mobility patterns, recommending a conceptual framework to better analyze the interactions between apps and physical mobility in cities. Still interested in the multimodal transportation behavior, McAuliffe Wells et al. (2021) analyze multimodal transportation behavior in the San Francisco Bay Area, identifying correlations between commuting styles and demographic, preference, and location-based factors. The study's classification tree approach can inform regional policies aimed at reducing vehicle use by promoting sustainable transportation alternatives.

Revolving around gender equality in shared mobility, Singh (2020) explores the rapid growth of the shared economy in the mobility sector, propelled by smartphone-based services. The research reviews existing studies to understand the impact of shared mobility on gender equality, finding that most research focuses on transit ridership, congestion, environmental factors, and modal shifts rather than gender-specific outcomes. Vătămănescu et al. (2023) propose a model for electric car sharing adoption, influenced by environmental consciousness and technology embracement. Their survey of Generation Z in Romania shows that while these factors significantly impact smart mobility, their effect on electric car sharing adoption is less pronounced. The study underscores the need for attitudinal and social habit changes to promote electric car sharing.

In what concerns the impact of emerging mobility tools, different angles of investigation have emerged. On the one hand, Sweet and Scott (2024) examine the adoption of emerging mobility tools in Southern Ontario, finding significant growth in ride hailing and telework post-pandemic. However, their impact on sustainable transportation remains unclear, raising questions about their role in climate policy and transportation planning. On the other hand, So et al. (2023) and Carrese et al. (2019) show their interest in location selection for smart mobility services, respectively in the role of reserved parking for car sharing. At this level, So et al. (2023) propose a two-step approach for selecting locations for urban air mobility services, combining obstacle analysis with an analytical hierarchy method. Their approach prioritizes suitable locations for takeoff and landing, supporting the integration of advanced mobility services in smart cities. Further, Carrese et al. (2019) emphasize the importance of reserved parking slots for car sharing vehicles in promoting the success of such services. They discuss how local governments can strategically select and configure these parking locations to enhance car sharing uptake.

A somehow more practical view of smart mobility gravitates around the utility of shared electric cars (SECs) and of pricing areas in car sharing, as inferred in the novel literature. In this regard, Julsrud and Standal (2023) explore the use of shared electric cars (SECs) in Norwegian organizations, identifying five community-based affordances that support sustainable mobility practices. These affordances include replacing private cars and promoting co-riding, highlighting the potential of SECs to reduce emissions during work-related travel. Brendel et al. (2022) develop a decision support system for constructing pricing areas in car sharing. By adjusting fees based on demand, the system reduces the need for vehicle relocations and improves vehicle availability, demonstrating a practical approach to managing car sharing operations. Taking the research to the next level, Xidias et al. (2023) underscore the management of semi-autonomous electric vehicles (SAEVs) and introduce an intelligent management system for relocating SAEVs in urban car sharing contexts. Their novel relocation strategy, based on platooning technology, aims to enhance the efficiency and sustainability of car sharing services.

3.2.3.1. Joint contribution and limitations of the studies linking smart mobility and multimodality. As in the case of the aforementioned topics, the investigation of smart mobility and multimodality has triggered a wide variety of methodological approaches and national contexts under scrutiny. The examinations clustered under this topic have been conducted via complex research methods and techniques, covering inductive statistical techniques and qualitative investigations, participatory group modeling building approach (GMB), fuzzy logic concepts and simulated experiments, Integer Linear Programming model, etc. Studies have been carried out in multiple countries, among which there are Canada, Greece, Italy, Norway, Romania, South Korea, Spain, Thailand, and US. Single country studies are still the norm whereas comparative analyses are totally missing. Therefore, a first shortcoming deriving from this situation lies in the predominance of one-sided insights into the debated issues.

In what concerns the research gaps identified by the body of

literature dedicated to smart mobility and modality, some key aspects may be considered for further scrutiny:

1. It remains unclear what factors make people more likely to adopt multimodal transportation behavior and emerging mobility technologies in modern urban environments. Questions remain about the speed of adoption, the demographics of adopters, and whether these technologies can effectively replace private vehicle use.
2. In terms of t**ransport poverty and mode choice, c**urrent research on transport poverty highlights social exclusions from mobility due to the unequal distribution of transportation options. Literature signals the need to shift focus from actual mode choice to potential or optional mode choice to better understand and address skepticism in studies on multimodal behaviors.
3. There is a notable lack of attention to how mobility services impact access, safety, ease, and comfort for females, whose travel needs differ significantly from males. Although there are speculations and expert opinions on these impacts, existing data shows that these services are predominantly used by men, potentially widening the gender gap in urban mobility.
4. It is still difficult to predict the future use of car sharing and its role in promoting sustainable mobility. The consistent study of the practices of early adopters may be considered a steppingstone, not a building block.
5. Data on the **consumer behavior in car sharing and smart mobility are still scant or polarized.** Understanding these behaviors is essential to facilitate the broader adoption and effectiveness of car sharing as a sustainable transport option based on technology embracement.

3.2.4. Topic 4: Sustainable mobility, public transport, and collaborative consumption

The fourth main topic covers the basic themes presented in the thematic map and integrates several research nodes, namely sustainable mobility, public transport, and collaborative consumption. These studies collectively underscore the complex interplay of factors influencing car sharing adoption and its potential to drive sustainable mobility transitions. They highlight the importance of understanding various factors affecting sustainable transportation options and collaborative consumption, the need for innovative solutions, and the potential of technology and business models in promoting sustainable mobility. The findings highlight the need for comprehensive policies, service quality improvements, and targeted interventions to promote car sharing and its integration into broader mobility systems.

Giving way to wider analytical frameworks, some studies underscore the need for integrated policies, technological innovation, and societal shifts in attitudes toward mobility to achieve sustainable transportation goals. In this regard, Chakraborty et al. (2021) conducted a bibliometric analysis of sustainable mobility, assessing the economic, environmental, and social impacts. Similarly, Shams Esfandabadi et al. (2022) reviewed the literature on car sharing, electrification, and automation, underscoring their significance in the transition to sustainable urban transport. Firnkorn and Shaheen (2016) previously called for a dynamic view of car sharing's impacts, proposing a shift from static to dynamic assessments to better support policymaking.

The attention paid to the socio-economic factors associated with sustainable transportation were under scrutiny from different perspectives. For instance, looking into the electric vehicle sharing programs (EVSPs) and participant attitudes, Kim et al. (2015) explored the factors influencing the attitudes of participants in the Seoul EVSP. The study used a web-based survey and found that social and economic perspectives significantly impact participant attitudes, with variations based on gender, age, and income. Going further, Kim et al. (2017) examined how latent satisfaction with current mobility options and uncertainty affect car sharing decisions. Using a hybrid choice model, the study revealed that satisfaction and car availability are important in deciding to join car sharing organizations. As for public car sharing and passenger loyalty, Ma et al. (2020) explored the factors influencing passenger loyalty in public car sharing, identifying perceived value, trust, and transaction costs as key mediators.

Focusing on the interest in intelligent mobility management (IMM) platforms, Keller et al. (2018) investigated the factors influencing the adoption of IMM platforms among car sharing scheme members. The study found high interest, with perceived advantage and personal compatibility being significant factors. The issue of the multifaceted challenges of mobility as a service (MaaS) was thoroughly discussed by Alyavina et al. (2020) who identified key themes such as car dependence and trust. They argued that the success of MaaS depends on shifting attitudes away from private car ownership, a challenging task that requires promoting public transport and incentivizing responsible MaaS usage. In this sense, Wong and Hensher (2021) examined mode-agnostic mobility contracts, identifying key attributes that influence the business community's interest in MaaS.

Mattia et al. (2019) applied the theory of planned behavior to understand the motives for reusing free-floating car sharing services, finding that economic, environmental, and social benefits significantly influence users' intentions while Coll et al. (2014) analyzed the socio-economic factors influencing car sharing membership in Québec City, finding that education and family structure significantly impact membership rates. In a similar front, Ali Aden et al. (2022) investigate traveler intentions and preferences toward car sharing in Djibouti through an online stated preference survey, revealing significant factors such as travel time, cost, and demographic characteristics in travel mode choice modeling. As a confirmation, Li and Zhang (2023) emphasize that attitudes, subjective norms, and perceived behavioral control directly influence car sharing intentions, with car ownership and gender moderating these effects.

Santos et al. (2010) considered soft policies like car sharing and eco-driving to promote behavioral change and sustainable mobility, emphasizing the role of research and development. The role of electric vehicles and modal shift policies (Di Gangi et al., 2022), of personal vehicle sharing (Shaheen et al., 2012) and of crowd-based relocation in car sharing (Brendel et al., 2022) are considered in the broad context of improving vehicle availability, environmental sustainability, and reduce operational costs in car sharing services and of assessing the effectiveness of eco-friendly mobility solutions. Pakusch et al. (2018) found that private car ownership is likely to remain prevalent, even with the advent of automated vehicles, although car sharing could benefit more from automation. However, they cautioned that the growth of car sharing might come at the expense of public transport, stressing the need to make public transport more attractive to support sustainable mobility. Likewise, Caulfield (2012) identified factors influencing multiple car ownership in Dublin, highlighting the potential of car sharing schemes to reduce the need for additional vehicles. In what concerns challenges and opportunities of shared sustainable mobility, Teles et al. (2018) examined the product-service system (PSS) business model's contribution to sustainability through electric car sharing projects, noting social benefits, and increased environmental awareness while Moro et al. (2023) analyzed the PSS business model in Brazil, emphasizing the co-creation of value and supporting the design of more sustainable business models.

The synthesis of the studies on sustainable transportation, car sharing and modal shares in transportation reveals several critical insights and challenges. To start with Santos et al. (2013) used a discrete choice modeling approach to identify factors influencing different transportation modes, providing policy recommendations to increase cycling and public transport shares. Kent and Dowling (2013) emphasized the complexity of changing deeply entrenched mobility practices, suggesting that car sharing's success hinges on its integration into everyday routines. Their later work (Dowling and Kent, 2015) highlighted the need for car sharing to be considered within broader transport policy debates, noting its potential to inform discussions on

behavior change and policy privatization. Willing et al. (2017) reached similar conclusions describing multimodal mobility platforms as essential tools for simplifying customer offerings and providing valuable data insights for mobility service providers. Concentrating on proactive intervention, Lemme et al. (2019) proposed an optimization model for evaluating different vehicle technologies in car sharing, suggesting that all vehicle types will play roles in the transition to sustainable mobility while Storme et al. (2021) reviewed new mobility services, emphasizing their potential to enhance efficiency, sustainability, and quality of life.

The research on car sharing practices presents a multifaceted analysis of their role in sustainable mobility transitions. Julsrud and Farstad (2020) highlight the importance of understanding the reproduction of car sharing practices as various performances to grasp their normalization in sustainability transitions. They propose a social practices approach to analyze these dynamics. Similarly, Jung and Koo (2018) examined the impact of car sharing on greenhouse gas emissions, finding that it can significantly reduce private vehicle and public transportation usage. Luna et al. (2020) studied the VAMO e-car sharing scheme in Brazil, demonstrating its effectiveness in reducing emissions and promoting electric vehicle awareness, underlining the role of government support.

Guglielmetti Mugion et al. (2019) find that service quality and perceived usefulness are critical drivers of car sharing usage, while Jonuschat, Stephan, and Schelewski (2015) demonstrate that car sharing can significantly reduce the carbon footprint of users by enabling intermodal trips and reducing private car dependence. As a corollary, Loorbach et al. (2021) explore transition governance to accelerate social, cultural, and technological changes for a sustainable mobility future, emphasizing shared and zero-emissions mobility, a topic also addressed by Meng et al. (2020) who stress the environmental benefits of free-floating car sharing, such as energy conservation and pollution reduction.

In terms of sustainable transportation planning, several research directions emerged. Firnkorn and Shaheen (2016) highlighted the potential of ICT tools to improve co-modality and reduce carbon emissions, emphasizing measures that decrease overall car usage whereas Shah et al. (2021) reviewed the challenges and barriers to implementing green transportation for global sustainability. The study identified the need for innovative technologies and management approaches to overcome these barriers and promote sustainable public transportation. Akyelken et al. (2018a,b) focused on the systemic barriers to car sharing expansion in urban contexts, noting the importance of understanding institutional and policy settings. Here, Tuominen et al. (2019) advocate for well-designed car sharing services to meet urban residents' mobility needs sustainably whereas Hoerler et al. (2021) recommend that policymakers consider the higher likelihood of car sharing users choosing electric vehicles. Conversely, Poltimäe et al. (2022) change the focus and discuss the need for integrated and flexible mobility solutions in rural areas, highlighting the importance of addressing diverse user needs for sustainable mobility.

3.2.4.1. Joint contribution and limitations of the studies linking sustainable mobility, public transport, and collaborative consumption. The exploration of sustainable mobility, public transport, and collaborative consumption availed a wealth of methodological approaches and national contexts under scrutiny. The studies clustered under this topic have been conducted via complex research methods and techniques, covering ordered probit and mixed logit models, minimization-based hybrid choice model, Bayesian D-efficient optimal design, D numbers, AHP, sensitivity analysis, structural equation modeling, time- and method-interdependencies, data analysis system (DAS), discrete choice experiment, multi-objective location-dependent two-stage stochastic optimization mode, logit dynamic evolution model, Binary Linear Programming problem and genetic-based matheuristic, longitudinal survey with latent transition analysis, stated choice experiment, error component random parameter logit model, causal loop diagram (CLD), etc. Empirical investigations have been coupled with theoretical approaches covering systematic literature reviews and bibliometric analyses, including grey literature.

The scope of the analyzed national contexts and international comparative analyses is wider than the one of the previous topics with studies dedicated to sport differences and similarities between sustainable transportations challenges and opportunities within and beyond national borders (i.e., Africa, Australia, Austria, Brazil, Canada, China, Finland, Germany, India, Israel, Italy, South Korea, Norway, Scotland, Sweden, Switzerland, the Netherlands, UK, US). European-centric investigations are still predominant with Italy and Northern countries being at the forefront of research. The emphasis is largely on urban areas, but the case of rural zones is also tackled.

In what concerns the research gaps identified by the body of literature regarding sustainable mobility, public transport, and collaborative consumption, the following issues arise:

1. Current research has largely overlooked the fact that differences in satisfaction with current mobility options affect individuals' car sharing decisions. This influence remains underexplored.
2. Sustainability assessment of transport measures is still an ongoing issue, often framed as a multiple criteria decision-making problem.
3. Although Integrated Multimodal Mobility (IMM) platforms are proposed as a solution for sustainable transport, their practical implementation and effectiveness, especially in diverse urban and rural contexts, require further investigation.
4. The impacts of B2B car sharing remain under-researched compared to the more studied business-to-consumer (B2C) segment.
5. In terms of barriers to car sharing adoption, employers' lack of data on employee travel patterns, insufficient economic incentives, and policies favoring private cars limit car sharing adoption. Also, addressing the challenge of balancing vehicle supply and demand is relevant for enhancing car sharing services.
6. Developing countries face significant mobility challenges due to poor connectivity in rural areas and the combined effects of urbanization and motorization. Effective integration of transport and land-use policy is essential to address these challenges.
7. Regarding the soft policies and environmental impact, mixed outcomes are debated. Car sharing has both positive and negative environmental effects, such as reduced CO2 emissions from more fuel-efficient vehicles and increased CO2 emissions from shifts from public transit to car sharing. The potential of car sharing to reduce CO2 emissions is acknowledged, but the aggregate impact on congestion and emissions lacks precise measurement. Moreover, the evidence for the impact of teleworking and teleshopping on reducing road transport is mixed.
8. Mobility as a Service (MaaS) aims to replace private cars with multimodal mobility packages, but its potential uptake and impact on current car drivers and public transport use are uncertain. Assessing the impact of new mobility systems like MaaS and Mobihubs is challenging due to varying stakeholder priorities and limited data availability. There is a limited understanding of the supply-side dynamics and new business models necessary for delivering integrated mobility services.
9. Few studies explore the relevance and sustainability of mobility solutions in rural contexts, typically focusing on specific user groups. Similarly, knowledge on urban form characteristics that promote sustainable car sharing scale-up and practical approaches for collaboration between private and public actors is needed.
10. Concerning equity in mobility options, the potential of car sharing to improve mobility options for disadvantaged people has received insufficient attention.

3.2.5. Topic 5: climate change and electric vehicles

By coupling the clusters referring to the relationships between car sharing and climate change, respectively electric vehicles, under the aegis of the niche theme, some major research streams can be delineated. The imperatives of identifying and capitalizing new mobility options with a view to reducing environmental impacts and climate change spring through various angles of investigation and interpretation.

In this vein, Keyvanfar et al. (2018) compared various policies aimed at reducing fuel consumption and carbon emissions, finding that driving behaviors like acceleration, deceleration, and speed compliance are of the essence. However, car sharing and carpooling appeared to be the least investigated approaches for mitigating climate change, despite their potential benefits. Baumgarte et al. (2022) found that understanding users' travel behavior is critical for expanding car sharing services in smaller urban areas. They identified four key groups of influencing factors: personal characteristics, time-related features, car-related features, and environmental features, highlighting the importance of time-related features for trip distance. In a similar approach, Abbasi et al. (2022) conducted a classification of car sharing members based on trip distance, revealing that station location and individual-level factors significantly affect mobility patterns. Their findings suggested that proximity to public transit and leisure areas positively influences trip distances. More recently, Albrecht et al. (2024) explored the use of generative machine learning models, such as GANs and VAEs, to create synthetic data for car sharing decision-making. They found that augmenting real training data with synthetic samples improved predictive modeling of trips, aiding researchers, and practitioners in developing better solutions for car sharing services.

In developing countries, Safdar et al. (2022) highlighted the rising motorization challenge and assessed public perception of car sharing in Lahore, Pakistan. They found that factors such as travel time, cost, waiting time, privacy, age, education, income, and driving license ownership significantly influence car sharing adoption. Similarly, Ampudia-Renuncio et al. (2020) analyzed free-floating car sharing (FFCS) in Madrid and found that trips were concentrated in low-populated, high-income districts with good parking and public transport connectivity, indicating the importance of these factors in car sharing demand.

Focusing on the relevance of electric vehicles in the equation of mitigating climate change, Galatoulas et al. (2018) focused on the development of electric vehicle sharing (EVS) services, suggesting that combining electro-mobility with car sharing is promising for sustainable transport. They examined demand and costs using an academic community as the target user base. Wang et al. (2020) emphasized the role of accurate demand forecasting models for electric car sharing systems to improve vehicle relocation efficiency and meet user trip demand. Later, Corinaldesi et al. (2022) proposed an e-car sharing system integrated with residential buildings, showing that such systems could reduce parking space and increase the use of on-site solar photovoltaics. Their mixed-integer linear optimization framework suggested economic potential for residential e-car sharing.

3.2.5.1. Joint contribution and limitations of the studies linking climate change and electric vehicles. Unlike the previous topics, the research node coupling climate change and electric vehicles is still in an embryonic phase as far as relevance is concerned. Few articles (i.e., 11) have been published in this area of interest, but they prove to have wide coverage in terms of country orientation and methodological approaches. Fine-grained research methods and techniques have been used to substantiate the research on this topic (i.e., stated preference survey, random utility-based model, Multinomial Logit Model (MNL), the Nested Logit Model (NL), Random Parameter Logit Model (RPL), Principal Component Analysis (PCA) and tree-based methods, multilevel mixed-effect modeling, etc.) whereas the empirical undertakings were carried out in Austria, China, Germany, South Korea, Pakistan, Spain and US. Comparative analyses are missing, thus calling for further transnational studies.

In terms of the research gaps which can be drawn from the study of climate change and electric vehicles, two issues have shown consistency. On the one hand, the current literature on free-floating car sharing systems (FFCS) primarily relies on survey-based methodologies and simulations, with insufficient scientific analysis of real flows using revealed web-based data. Addressing this gap is mandatory, as FFCS has the potential to significantly reduce carbon emissions and traffic congestion, thereby mitigating climate change. On the other hand, advancements in vehicle telematics systems have greatly benefited drivers and fostered the development of smart transportation systems. Utilizing in-vehicle sensor data to analyze driving behaviors presents an attractive research challenge with significant implications for the automobile industry. Despite these technological advancements, there is a growing concern over increased auto-theft rates, false trips, and the use of fake accounts to receive bonuses in car sharing services. These issues not only hinder the efficiency of smart transportation systems but also impede efforts to reduce greenhouse gas emissions and combat climate change.

3.2.6. Topic 6: transport policy and automotive industry

According to the density and centrality coordinates, the topic concerning transport policy and automotive industry is the least representative, being indicative of emerging or declining themes. As most of the articles in these clusters are not very recent (i.e., they were published more than five years ago), and as derived from the focus of their analyses, we may contend that they mainstream rather declining than emerging themes.

Arising among the first studies addressing transport policy and automotive industry, Kandt et al. (2015) compare mobility attitudes and behaviors in Berlin and London, revealing significant potential for sustainable travel if transport policies are tailored to specific demographic needs and local mobility cultures. The study underscores the importance of geographically targeted interventions to enhance the effectiveness of sustainable transport policies. Adopting a more proactive approach, Le Boennec et al. (2019) propose a decision-aid tool for local authorities to plan sustainable transport policies in low-density areas. The tool emphasizes carpooling combined with walking, supported by a robust mobility application, demonstrating innovative approaches to reduce car dependency and promote sustainable transport.

Looking into the socio-economic profiles of prospective consumers, Kawgan-Kagan (2015) finds that e-car sharing users are predominantly middle-aged, well-educated, high-income men with full-time employment. Female early adopters, often underrepresented, prefer battery electric vehicles (BEVs) over internal combustion engines, and combine e-car sharing with public transport and bicycling, indicating a multifaceted approach to urban mobility. This highlights the importance of targeting women in e-car sharing initiatives to enhance sustainable transportation options and empowered decisions in the automotive industry. Furthermore, Mouratidis (2022) provides new insights into the factors influencing the use of shared mobility options, including bike-sharing, e-scooter sharing, car sharing, and ride hailing (Uber). Car sharing users tend to live in transit-oriented neighborhoods without private cars, while Uber users are generally younger, less educated, and live near city centers. These findings emphasize the role of compact urban forms and transit accessibility in promoting sustainable mobility and transport equity. Other findings (Svennevik, 2019) suggest that car sharing reduces car ownership and usage, promoting sustainable mobility. However, the continued use of fossil fuel cars limits its environmental benefits, underscoring the need for transitioning to electric vehicles within car sharing schemes.

Marx et al. (2014) analyze the varying development levels of sustainable mobility initiatives in Germany and Brazil. They find that German companies are moderately innovative in mobility, whereas Brazilian efforts are limited, focusing more on traditional vehicle sales.

The differences stem from varying infrastructures, public pressures, and institutional conditions, highlighting the need for tailored strategies and transport policy in advancing sustainable mobility in different regions. In a different approach, Hildermeier (2016) explores the impact of publicly funded EV demonstration projects in shaping EV use and acceptance in the absence of strong demand. The study reveals that most projects adhere to conventional automobility, with limited efforts towards alternative mobility patterns like e-car sharing or intermodal integration. This indicates a need for more innovative public projects to foster sustainable mobility solutions.

In the context of the post-COVID "new normal", Zhang and Zhang (2021) examine its potential to drive sustainable transport through reduced energy consumption and CO2 emissions. Scenario simulations show significant emission reductions through remote work, online shopping, and bike-friendly infrastructure. Conversely, increased car usage and reduced car sharing services could hinder emission reduction efforts. This highlights the need for transport policies promoting sustainable transport behaviors post-COVID. Still in the context of topical preoccupations, Ševčenko-Kozlovska and Čižiūnienė (2022) highlight the commuting patterns of migrants, who predominantly use public transport, walking, cycling, or car sharing. Over time, as living standards improve, migrants' transportation preferences increasingly align with those of locals, emphasizing the need for sustainable transport solutions that cater to diverse demographic changes.

3.2.6.1. Joint contribution and limitations of the studies on transport policy and automotive industry. The articles dedicated to this topic are scant and are characterized by low development and relevance. Though few, they manage to express their case through a variety of research methodologies (i.e., individual-level geospatial data, multi-criteria decision analysis (MCDA), correlation and regression analyses used in the article and the application of the ALM (automatic linear modelling), etc.) and of national units of analysis (i.e., Brazil, Germany, Norway, UK, US).

In terms of research gaps, some areas are indicated as subject to further improvement. On the one hand, to effectively advance transport policy, it is essential to address the specific requirements of diverse car sharing trips, such as those involving the transportation or accompaniment of children. This approach will ensure that sustainable mobility options extend beyond the typical early adopters, making car sharing a viable choice for a broader range of users. On the other hand, research should delve into the European car market which faces a significant paradox. Despite substantial public investments in electric vehicle (EV) development and demonstration projects, a mass market for EVs has yet to emerge. Additionally, although car sharing usage has grown rapidly in recent years, the overall number of users remains low, and privately owned cars continue to dominate the market. Addressing these gaps is pivotal for developing effective transport policies that promote sustainable mobility solutions.

4. Conclusions and future research directions

Giving credit to the recommendations of Paul and Criado (2020) for systematic literature reviews, the purpose of the current endeavor was to provide solid foundations for research development, by acknowledging the added value of what has been already done (thus answering the first two research questions), by pointing to the limitations and research gaps waiting to be filled in (thus answering the third research question), and by availing key points of a future research agenda on the topic (thus answering the fourth question). By applying the SPAR-4-SLR protocol and analyzing 173 peer-reviewed articles published in journals indexed in Scopus database, the foundation, critique, and transformative redefinitions were brought forward to clarify the multiplexity of links between the terms associated with smart mobility and car sharing. Light was shed on the motor, basic, niche, and emerging/declining themes, which included eight clusters.

Unlike prior developments, the originality of the current study resided in simultaneously examining car sharing and smart mobility, displaying their complementarity, achievements and areas for improvement in a comprehensive manner. Given the variations in scope and the similarity of focus, the identified clusters were further grouped into six main topics: 1. Car sharing through the lens of urban mobility management, innovative business models and governance, 2. Sustainable transportation and e-car sharing, 3. Smart mobility and multimodality (emerged as motor themes), 4. Sustainable mobility, public transport, and collaborative consumption (emerged as a basic theme), 5. Climate change and electric vehicles (emerged as a niche theme) and 6. Transport policy and automotive industry (emerged as a declining theme).

As derived from the previous discussions, the delimitations between the advanced research topics are very permeable at the conceptual level, most of the studies developing integrative approaches on the relationship between smart mobility and car sharing services. For instance, the scope of the first three topics often included references to climate change and transport policy to better support their argumentative foundation. The thematic map is nevertheless a useful knowledge structure which provides a thorough organization of the conceptual frameworks in which the correlative scrutiny of car sharing, and smart mobility dynamics has unfolded over the years. It therefore offers milestones of what is already common knowledge in the field, displaying a high degree of relevance but lower development (i.e., basic themes), of what is both relevant and well developed (i.e., motor themes), of what is well developed but less relevant (niche themes) and of what is less relevant and developed (i.e., declining themes). It provides researchers with valuable insights into the state-of-the-art and guides the examination of future research avenues.

In this vein, despite the fact that smart mobility and car sharing adoption have gained momentum, the limitations of the studies conducted in this area and the imperative to carry out new investigations should be acknowledged accordingly. Firstly, most studies have a limited geographical scope, focusing mainly on urban areas in developed countries. This restricts the generalizability of findings to rural or under-developed areas lacking infrastructure or cultural acceptance of these practices. Secondly, the existing empirical investigations predominantly focus on specific countries such as the Western European countries, China, US, and Australia, which may limit the generalizability of their findings to other national contexts. Transnational comparative analyses are scant and generally focused on similarly developed countries or cities. Thirdly, despite a wide array of methodological designs and techniques, there is a scarcity of longitudinal studies and data, with many research efforts focusing on short-term impacts or providing cross-sectional snapshots. Few studies evaluate the long-term effects of smart mobility over extended periods which limits the ability to establish causal relationships and measure long-term impacts. Furthermore, sufficient endeavors on this topic rely on survey analysis methods and self-reported data, introducing the potential for biases and inaccuracies in participants' responses.

4.1. Theoretical implications: toward a future research agenda

Pursuant to Alvesson and Deetz (2000, p. 21), the corollary of systematic literature reviews lies in the transformative redefinitions which tie together the insights and critique of the literature, by directing researchers "to avoid hyper-critique and negativity and offers a positive way forward". This is how critical and noteworthy knowledge, respectively practical implications and comprehension are settled as prerequisites for new ways of operating.

As showcased before, the mapping and mainstreaming of the specialized literature reveals that an incomplete understanding of user behavior and decision-making processes related to car sharing persists. While significant discoveries and developments have been achieved, there are still important research problems to be solved. For example,

socio-economic factors are often overlooked, disregarding the influence of gender, income, education, residence, and alternative transportation availability on car sharing adoption and usage. Another noteworthy limitation refers to the fact that there are nascent and fragmented assessments of car sharing and smart mobility negative impacts, such as increased traffic congestion, decrease in public transport demand, passenger safety, or privacy concerns arising among others. Further, although some studies examine the impact of specific policies, there is a lack of comprehensive evaluations of policy effectiveness in different contexts.

With a view to advance a more precise and comprehensive outlook of the extant theoretical and empirical limitations, thus providing a more focused answer to the fourth research question (RQ4. What are the implications of this literature in terms of future research avenues?), Table 9 summarized a structured research agenda. For each of the six analyzed topics, the main research lines to be considered by scholars are highlighted in an interrogative manner.

The acknowledgment of these research questions alongside the provision of tentative answers would yield benefits and commendable implications for scholars, practitioners, owners and managers of CS companies and policymakers simultaneously.

4.2. Business and policy implications

By delving into the insights and critical analysis availed by the discussion of the six research topics, all stakeholders may benefit from an overview of the dynamics, utility and limitations of the current business models, governance structures and policies associated with mobility services, of the positive and perverse effects of car sharing and smart mobility in relation to customers' expectations, urban planning, traffic congestion, air quality, and CO2 emissions, of the role of practical actors, such as car sharing operators, which is of utmost importance for successful collaboration and service sustainability, of the growth opportunities and barriers to the widespread electric vehicle adoption, etc. In this front, the current systematic literature review has brought to the attention key research lines and practical implications which may assist and empower knowledgeable stakeholders to rethink their approaches, business strategies or transport policies.

Revolving around the implications of car sharing and smart mobility for CS companies, some areas emerge as very significant. In terms of market expansion and technological investment, the growing interest in smart mobility provides an opportunity for car sharing companies to tap into new markets and demographics and to further invest in technology, including apps, fleet management systems, and data analytics to enhance user experience and operational efficiency. Additionally, car sharing companies must ensure their business models are economically viable, balancing costs with pricing strategies that are attractive to consumers while also assuming sustainability commitments. Capitalizing on their eco-friendly public perception, CS companies may be expected to increase their use of electric or hybrid vehicles.

Moving further, the extant literature signals the exigency of partnerships with public transit agencies, municipalities, and other mobility services to create integrated transportation solutions. Smart mobility initiatives may lead to changes in urban infrastructure, affecting how car sharing companies optimize the allocation and parking of their fleets. In this vein, companies must navigate complex and evolving regulations concerning transportation services, data security, and user privacy. They are subject of both challenges and opportunities to innovate, collaborate, and grow within an ever-changing transportation ecosystem.

For policymakers, the implications of car sharing, and smart mobility are substantial, encompassing urban planning, transportation infrastructure, environmental policy, and social equity. On the one hand, policy decisions may need to support infrastructure investments that cater to smart mobility solutions, such as charging stations for electric shareable vehicles. At this level, smart mobility can influence urban design, from zoning laws to the allocation of parking and road space and

Table 9
Future research questions derived from the investigated topics.

Research topics	Future research questions
1 Car sharing through the lens of urban mobility management, innovative business models and governance	1.1. To what extent can be car sharing integrated with urban planning? 1.2. What are the main psychosocial facilitators and detractors for car sharing adoption? 1.3. What is the actual customer interest in vehicle-to-grid car sharing? 1.4. How can autonomous car sharing services reach their full potential? 1.5. How are car sharing-facilitating neighborhoods supporting urban mobility management?
2 Sustainable transportation and e-car sharing	2.1. What is the impact of free-floating car sharing on sustainable transport indicators? 2.2. How do consumer concerns affect their perception of the economic benefits of EV ownership? 2.3. What policy or intervention measures are accountable for positive mobility-related attitudes of prospective passengers? 2.4. What are the main coordinates of e-car sharing in less developed countries?
3 Smart mobility and multimodality	3.1. What are the factors determining people to adopt multimodal transportation behavior in modern urban environments? 3.2. What are the stakeholders' perceptions and mindsets regarding the benefits of multimodality? 3.3. What are the main factors impeding the speed of adoption of emerging mobility technologies? 3.4. How do mobility services impact access, safety, ease, and comfort in terms of gender or education? 3.5. To what extent is car sharing expected to become a pertinent substitute to fossil-fueled private cars in the near future?
4 Sustainable mobility, public transport, and collaborative consumption	4.1. To what extent are Integrated Multimodal Mobility (IMM) platforms a practical solution for urban and rural contexts? 4.2. What is the manifold impact of B2B car sharing on sustainable mobility? 4.3. How can the mobility challenges caused by poor connectivity be resolved in developing countries? 4.4. What is the aggregate impact of car sharing on congestion and CO2 emissions? 4.5. To what extent can Mobility as a Service (MaaS) replace private cars with multimodal mobility packages?
5 Climate change and electric vehicles	5.1. To what extent can free-floating car sharing systems (FFCS) reduce carbon emissions and traffic congestion? 5.2. How do telematics systems benefit the development of smart transportation systems?
6 Transport policy and automotive industry	6.1. How can transport policy support sustainable mobility options beyond the typical early adopters? 6.2. How can the automotive industry stimulate a mass market for electric vehicles and for their usage in car sharing services?

Source: Authors' own processing

requires integration into long-term urban planning. By supporting public-private partnerships, policymakers may enhance overall mobility and create incentives to promote eco-friendly options within shared mobility.

On the other hand, policymakers are challenged to foster multimodal transportation options, creating seamless transportation networks that integrate car sharing with other modes of public and active transport. Smart mobility and car sharing can be managed to reduce traffic congestion only through adequate measures like dynamic pricing models or congestion charges, otherwise their overall impact would be limited., Finally, policymakers must address data protection and privacy concerns, given the amount of user data collected by smart mobility services. Moreover, ensuring the safety of shared and smart vehicles, including autonomous vehicles, is decisive for public acceptance and long-term success. By considering these implications and creating thoughtful, forward-looking policies, policymakers can help guide the evolution of car sharing and smart mobility to enhance urban living and meet sustainable transportation goals.

4.3. Limitations of the current endeavor and future research directions

Even though, to the best of our knowledge, this is the first systematic literature review correlatively tackling the relationship between smart mobility and car sharing, the current endeavor has several limitations which should be acknowledged as such.

Firstly, even though the search query string was sufficiently holistic, the systematic literature review has mainly focused on the correlative study of smart mobility and car sharing issues, thus not covering multidimensional factors conducive to car sharing adoption. Here, future research may envisage considering multi-factor frameworks for the investigation of car sharing antecedents.

Secondly, the study relied on a single database (i.e., Scopus) and on 173 peer-reviewed articles as inputs for the data analysis. Although various arguments were provided in the methodological section for the database selection, future undertakings may benefit from extending the analysis to other relevant databases (i.e., Web of Science), on other source types (i.e., books, chapters, conference papers or grey literature).

Thirdly, the descriptive analysis of the data revolved around some key points as generated by the usage of the Bibliometrix application. Further examinations may include additional metrics which are made available by this bibliometric application or others (i.e., VOSviewer) or by content analysis applications (i.e., NVivo, Atlas.ti) on purpose to round off the general outlook.

CRediT authorship contribution statement

Elena-Mădălina Vătămănescu: Writing – review & editing, Writing – original draft, Supervision. **Gandolfo Dominici:** Writing – original draft, Validation, Supervision, Project administration, Investigation, Conceptualization. **Victor-Emanuel Ciuciuc:** Software, Formal analysis. **Alexandra Vițelar:** Visualization, Validation, Resources, Conceptualization. **Flavia Gabriela Anghel:** Methodology, Data curation.

Funding

This research received no external funding.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

Not applicable.

Appendix

Table 1A
Main insights from the existing systematic literature reviews and bibliometric analyses on the topic in Scopus database
Search string = (TITLE-ABS-KEY ("smart mob*" OR "smart transport*" OR "intelligent mob*" OR "intelligent transport*" OR "sustainable transport*" OR "sustainable mob*") AND (TITLE-ABS-KEY ("car shar*" OR "car-shar*" OR "carsharing") AND DOCTYPE (re)

	Year	Authors	Title	Main Contributions	Journal	Article Review Count	L.R.: Car Sharing	L.R.: Smart Mobility
1	2024	Alam T.; Gupta R.; Nasurudeen Ahamed N.; Ullah A.; Almaghthwi A.	Smart mobility adoption in sustainable smart cities to establish a growing ecosystem: Challenges and opportunities	- Smart mobility is the integration of technologies and different mobility solutions - It establishes interconnected transport networks that transport individuals and products more efficiently and sustainably	MRS Energy and Sustainability	72		X
2	2024	Eliyan A.F.; Kerbache L.	Vehicle Relocation in One-Way Carsharing: A Review	- Carsharing has become increasingly popular in recent years as a sustainable transportation solution, offering individuals access to shared vehicles on a short-term basis - One-way carsharing, in particular, presents unique challenges due to its flexible nature, allowing users to pick up and drop off vehicles at different locations within a designated service area	Sustainability (Switzerland)	54	X	
3	2024	Wang Y.; Zhu Y.; Wei C.; Jiang M.; Yamamoto T.	Carsharing Worldwide: Case Studies on Carsharing Development in China, Europe, Japan, and the United States	- Carsharing has received considerable attention as a sustainable mobility paradigm	Sustainability (Switzerland)	24	X	

(*continued on next page*)

Table 1A (*continued*)

	Year	Authors	Title	Main Contributions	Journal	Article Review Count	L.R.: Car Sharing	L.R.: Smart Mobility
				- Various service designs and dynamic business environments have increased the decision complexity for the carsharing business				
4	2023	Zhu J.; Xie N.; Cai Z.; Tang W.; Chen X.	A comprehensive review of shared mobility for sustainable transportation systems	- The study puts forth a comprehensive review of the significant elements in sustainable transportation systems with shared mobility - The main subsets of shared mobility include: ridesharing, carsharing, shared micromobility, on-demand ride services, and shared autonomous vehicles (SAVs)	International Journal of Sustainable Transportation	201		X
5	2023	Mavlutova I.; Atstaja D.; Grasis J.; Kuzmina J.; Uvarova I.; Roga D.	Urban Transportation Concept and Sustainable Urban Mobility in Smart Cities: A Review	- To create a sustainable future for the urban environment in smart cities, it is necessary to develop a concept of urban transport (i.e. to partially reduce the use of traditional transport, primarily cars, as well as the environmental pressure on society, which is essential to move to a sustainable urban future) - In the latest discussions on the future of the urban transport system, the quality of the environment, and the possibility of its improvement are discussed, this issue became especially relevant with the onset of the pandemic, when the lockdowns were introduced	Energies	580		X
6	2022	Poltimäe H.; Rehema M.; Raun J.; Poom A.	In search of sustainable and inclusive mobility solutions for rural areas	- Background: Despite emerging research on novel mobility solutions in urban areas, there have been few attempts to explore the relevance and sustainability of these solutions in rural contexts - The authors underline that existing research addresses rural mobility solutions, which typically focuses on a specific user group, such as local residents, second-home owners, or tourists	European Transport Research Review	91		X
7	2022	Shams Esfandabadi Z.; Diana M.; Zanetti M.C.	Carsharing services in sustainable urban transport: An inclusive science map of the field	- Vehicle sharing, electrification, and automation, as the triple revolutions in urban transportation, have been under scrutiny in the pursuit of crafting a new transport paradigm - In this regard, car-sharing services, as a potential solution for sustainable urban transport, have gained momentum within the context of sustainable cities in recent years	Journal of Cleaner Production	141	X	
8	2021	Chakraborty S.; Kumar N.M.; Jayakumar A.; Dash S.K.; Elangovan D.	Selected aspects of sustainable mobility reveals implementable approaches and conceivable actions	- The transportation sector plays a prominent role in driving the economy of any given nation - However, with the recent tensions arising in and around the transportation sector, sustainable mobility concepts have evolved	Sustainability (Switzerland)	207	X	
9	2021	Storme T.; Casier C.; Azadi H.; Witlox F.	Impact assessments of new mobility services: A critical review	- The article extensively discusses, ponders and assesses the impact of new mobility systems	Sustainability (Switzerland)	110		X
10	2019	Mattia G.; Guglielmetti Mugion R.; Principato L.	Shared mobility as a driver for sustainable consumptions: The intention to re-use free-floating car sharing	- Free-floating car sharing allows customers to rent a shared car on a per-minute rate of use, with liberty of withdrawal and return - The present study aims to enhance the knowledge of motives for re-use of free-floating car sharing through the theory of planned behavior	Journal of Cleaner Production	79	X	

(*continued on next page*)

Table 1A (*continued*)

	Year	Authors	Title	Main Contributions	Journal	Article Review Count	L.R.: Car Sharing	L.R.: Smart Mobility
11	2019	Guo G.; Xu Y.-G.; Xu T.; Li D.-D.; Wang Y.-P.; Yuan W.	A survey of connected shared vehicle-road cooperative intelligent transportation systems; [网联共享车路协同智能交通系统综述]	- Connected vehicles, big traffic data, car-sharing and other technologies provide opportunities and challenges to the development and application innovation of intelligent transportation systems (ITS) - Based on a comprehensive summary of the latest research results in the fields of car-sharing systems, collaborative optimal control of connected vehicles, and traffic data analysis, a systematic survey of the research progress of intelligent transportation technologies is proposed: consequently, a comprehensive review is made from perspectives of traffic flow and travel demand prediction, vehicle dispatching of mobility-on-demand systems, joint optimization of the transportation network and power grid, cooperative control of connected vehicles and vehicle-road collaborative control	Kongzhi yu Juece/ Control and Decision	160	X	
12	2015	Chester M.V.	Can Disruptive Technologies, On-Demand Mobility, and Biofuels Improve Transportation Environmental Sustainability? A Review of Recent Research	- As new transportation technologies, travel behaviours, and fuels emerge, there is an opportunity to proactively assess environmental impacts to ensure that reductions occur and unintended tradeoffs are avoided - This article summarises the goals, scope, and findings of a special issue on transportation sustainability	Current Sustainable/ Renewable Energy Reports	4	X	
13	2010	Santos G.; Behrendt H.; Teytelboym A.	Part II: Policy instruments for sustainable road transport	- Without questioning the fact that to achieve efficiency, emitters should pay for the true costs of their actions (a core principle of economic policies - such as pollution taxes), the article puts under the limelight sufficient evidence in the literature to demonstrate that many other policy instruments can be used in combination with taxes and permits to ensure that the transport needs of the present generation can be met without compromising the ability of future generations to meet any needs of their own - The policies and policy aspects considered in this paper broadly fall into three categories: physical policies, soft policies, and knowledge policies	Research in Transportation Economics	392	X	

Data availability

Data will be made available on request.

References

Abbasi, S., Ko, J., Kim, J., 2022. Carsharing travel distance and its associated factors: a case study of Seoul, South Korea. J. Clean. Prod. 362, 132380. https://doi.org/10.1016/j.jclepro.2022.132380.

Aguilera-García, Á., Gomez, J., Antoniou, C., Vassallo, J.M., 2022. Behavioral factors impacting adoption and frequency of use of carsharing: a tale of two European cities. Transport Pol. 123, 55–72. https://doi.org/10.1016/j.tranpol.2022.04.007.

Akyelken, N., Banister, D., Givoni, M., 2018a. The sustainability of shared mobility in London: the dilemma for governance. Sustainability 10 (2), 420. https://doi.org/10.3390/su10020420.

Akyelken, N., Givoni, M., Salo, M., Plepys, A., Judl, J., Anderton, K., Koskela, S., 2018b. The importance of institutions and policy settings for car sharing – evidence from the UK, Israel, Sweden and Finland. Eur. J. Transport Infrastruct. Res. 18 (4), 340–359. https://doi.org/10.18757/ejtir.2018.18.4.3253.

Al-Addal, S.I.K., 2021. Using the smartphone in carpooling for new mobility services. Period. Eng. Nat. Sci. 9 (1), 301–307. https://doi.org/10.21533/pen.v9i1.1799.

Albrecht, T., Keller, R., Rebholz, D., Röglinger, M., 2024. Fake it till you make it: synthetic data for emerging carsharing programs. Transport. Res. Transport Environ. 127, 104067. https://doi.org/10.1016/j.trd.2024.104067.

Ali Aden, W., Zheng, J., Ullah, I., Safdar, M., 2022. Public preferences towards car sharing service: the case of Djibouti. Front. Environ. Sci. 10, 889453. https://doi.org/10.3389/fenvs.2022.889453.

Alonso-Almeida, M.d.M., 2019. Carsharing: another gender issue? Drivers of carsharing usage among women and relationship to perceived value. Travel Behaviour and Society 17, 36–45. https://doi.org/10.1016/j.tbs.2019.06.003.

Alvesson, M., Deetz, S., 2000. Doing Critical Management Research. Sage.

Alyavina, E., Nikitas, A., Tchouamou Njoya, E., 2020. Mobility as a service and sustainable travel behaviour: a thematic analysis study. Transport. Res. F Traffic Psychol. Behav. 73, 362–381. https://doi.org/10.1016/j.trf.2020.07.004.
Ampudia-Renuncio, M., Guirao, B., Molina-Sanchez, R., Bragança, L., 2020. Electric free-floating carsharing for sustainable cities: characterization of frequent trip profiles using acquired rental data. Sustainability 12 (3), 1248. https://doi.org/10.3390/su12031248.
Aria, M., Cuccurullo, C., 2017. Bibliometrix: an R-tool for comprehensive science mapping analysis. Journal of Informetrics 11 (4), 959–975.
Awasthi, A., Chauhan, S.S., 2011. Using AHP and Dempster–Shafer theory for evaluating sustainable transport solutions. Environ. Model. Software 26 (6), 787–796. https://doi.org/10.1016/j.envsoft.2010.11.010.
Awasthi, A., Omrani, H., Gerber, P., 2018. Investigating ideal-solution based multicriteria decision making techniques for sustainability evaluation of urban mobility projects. Transport. Res. Pol. Pract. 116, 247–259. https://doi.org/10.1016/j.tra.2018.06.007.
Baumgarte, F., Keller, R., Röhrich, F., Valett, L., Zinsbacher, D., 2022. Revealing influences on carsharing users' trip distance in small urban areas. Transport. Res. Transport Environ. 105, 103252. https://doi.org/10.1016/j.trd.2022.103252.
Bocken, N., Jonca, A., Södergren, K., Palm, J., 2020. Emergence of carsharing business models and sustainability impacts in Swedish cities. Sustainability 12 (4), 1594. https://doi.org/10.3390/su12041594.
Brendel, A.B., Lichtenberg, S., Brauer, B., Nastjuk, I., Kolbe, L.M., 2018. Improving electric vehicle utilization in carsharing: a framework and simulation of an e-carsharing vehicle utilization management system. Transport. Res. Transport Environ. 64, 230–245. https://doi.org/10.1016/j.trd.2018.01.024.
Brendel, A.B., Lichtenberg, S., Morana, S., Prinz, C., Hillmann, B.M., 2022. Designing a crowd-based relocation system - the case of car-sharing. Sustainability 14 (12), 7090. https://doi.org/10.3390/su14127090.
Butler, L., Yigitcanlar, T., Paz, A., 2020. Smart urban mobility innovations: a comprehensive review and evaluation. IEEE Access 8, 196034–196049. https://doi.org/10.1109/access.2020.3034596.
Carrese, S., d'Andreagiovanni, F., Giacchetti, T., Nardin, A., Zamberlan, L., 2019. Optimal rental and configuration of reserved parking for carsharing by integer linear programming and ant colony optimization. Adv. Transport. Stud. 3, 63–76. https://doi.org/10.4399/97888255317946.
Caulfield, B., 2012. An examination of the factors that impact upon multiple vehicle ownership: the case of Dublin, Ireland. Transport Pol. 19 (1), 132–138. https://doi.org/10.1016/j.tranpol.2011.08.003.
Chakraborty, S., Kumar, N.M., Jayakumar, A., Dash, S.K., Elangovan, D., 2021. Selected aspects of sustainable mobility reveals implementable approaches and conceivable actions. Sustainability 13 (22), 12918. https://doi.org/10.3390/su132212918.
Cobo, M.J., López-Herrera, A.G., Herrera-Viedma, E., Herrera, F., 2011. An approach for detecting, quantifying, and visualizing the evolution of a research field: a practical application to the fuzzy sets theory field. Journal of Informetrics 5 (1), 146–166.
Cohen, B., Kietzmann, J., 2014. Ride on! Mobility business models for the sharing economy. Organ. Environ. 27 (3), 279–296. https://doi.org/10.1177/1086026614546199.
Coll, M.-H., Vandersmissen, M.-H., Thériault, M., 2014. Modeling spatio-temporal diffusion of carsharing membership in Québec City. J. Transport Geogr. 38, 22–37. https://doi.org/10.1016/j.jtrangeo.2014.04.017.
Corinaldesi, C., Lettner, G., Auer, H., 2022. On the characterization and evaluation of residential on-site E-car-sharing. Energy 246, 123400. https://doi.org/10.1016/j.energy.2022.123400.
De Bem Machado, A., Secinaro, S., Calandra, D., Lanzalonga, F., 2022. Knowledge management and digital transformation for Industry 4.0: a structured literature review. Knowl. Manag. Res. Pract. 20 (2), 320–338. https://doi.org/10.1080/14778238.2021.2015261.
Degirmenci, K., Lapin, S., Breitner, M.H., 2017. Critical success factors of carsharing and electric carsharing: findings from expert interviews in Continental Europe. Int. J. Automot. Technol. Manag. 17 (3), 294–315. https://doi.org/10.1504/IJATM.2017.086413.
Delgado-Fernández, V.J., Rey-Merchán, M. del C., López-Arquillos, A., Choi, S.D., 2022. Occupational traffic accidents among teachers in Spain. Int. J. Environ. Res. Publ. Health 19 (9), 5175. https://doi.org/10.3390/ijerph19095175.
Di Gangi, M., Comi, A., Polimeni, A., Belcore, O.M., 2022. E-bike use in urban commuting: empirical evidence from the home-work plan. Archives of Transport 62 (2), 91–104. https://doi.org/10.5604/01.3001.0015.9568.
Diao, M., Kong, H., Zhao, J., 2021. Impacts of transportation network companies on urban mobility. Nat. Sustain. 4 (6), 494–500. https://doi.org/10.1038/s41893-020-00678-z.
Dirsehan, T., van Zoonen, L., 2022. Smart city technologies from the perspective of technology acceptance. IET Smart Cities 4, 197–210. https://doi.org/10.1049/smc2.12040.
Dowling, R., Kent, J., 2015. Practice and public–private partnerships in sustainable transport governance: the case of car sharing in Sydney, Australia. Transport Pol. 40, 58–64. https://doi.org/10.1016/j.tranpol.2015.02.007.
Drobiazgiewicz, J., Pokorska, A., 2023. Directions of carsharing development in Poland—analysis of the need to expand the carsharing zone. Sustainability 15 (5), 4192. https://doi.org/10.3390/su15054192.
Duncan, M., 2011. The cost saving potential of carsharing in a US context. Transportation 38 (2), 363–382. https://doi.org/10.1007/s11116-010-9304-y.
Eliyan, A.F., Kerbache, L., 2024. Vehicle relocation in one-way carsharing: a review. Sustainability 16 (3), 1014. https://doi.org/10.3390/su16031014.
Elsbach, K.D., van Knippenberg, D., 2020. Creating high-impact literature reviews: an Argument for "integrative reviews". J. Manag. Stud. 57 (6), 1277–1289. https://doi.org/10.1111/joms.12581.
European Commission, 2019. TRIMIS dashboard. https://trimis.ec.europa.eu/dashboard.
Firnkorn, J., Shaheen, S., 2016. Generic time- and method-interdependencies of empirical impact-measurements: a generalizable model of adaptation-processes of carsharing-users' mobility-behavior over time. J. Clean. Prod. 113, 897–909. https://doi.org/10.1016/j.jclepro.2015.09.115.
Galatoulas, N.-F., Genikomsakis, K.N., Ioakimidis, C.S., 2018. Analysis of potential demand and costs for the business development of an electric vehicle sharing service. Sustain. Cities Soc. 42, 148–161. https://doi.org/10.1016/j.scs.2018.07.008.
Groth, S., 2019. Multimodal divide: reproduction of transport poverty in smart mobility trends. Transport. Res. Pol. Pract. 125, 56–71. https://doi.org/10.1016/j.tra.2019.04.018.
Gu, G., Feng, T., Zhong, C., Cai, X., Li, J., 2021. The effects of life course events on car ownership and sustainable mobility tools adoption decisions: results of an error component random parameter logit model. Sustainability 13 (12), 6816. https://doi.org/10.3390/su13126816.
Guglielmetti Mugion, R., Toni, M., Di Pietro, L., Pasca, M.G., Renzi, M.F., 2019. Understanding the antecedents of car sharing usage: an empirical study in Italy. International Journal of Quality and Service Sciences 11 (4), 523–541. https://doi.org/10.1108/ijqss-02-2019-0029.
Günther, M., Jacobsen, B., Rehme, M., Götze, U., Krems, J.F., 2020. Understanding user attitudes and economic aspects in a corporate multimodal mobility system: results from a field study in Germany. Eur. Transp. Res. Rev. 1 (12). https://doi.org/10.1186/s12544-020-00456-0.
Hartl, B., Hofmann, E., 2022. The social dilemma of car sharing – the impact of power and the role of trust in community car sharing. International Journal of Sustainable Transportation 16 (6), 526–540. https://doi.org/10.1080/15568318.2021.1912224.
Hildermeier, J., 2016. Which role should the electric car play in Europe's cities? An analysis of publicly funded demonstration projects 2007-2013. Int. J. Automot. Technol. Manag. 16 (1), 90–107. https://doi.org/10.1504/ijatm.2016.076451.
Hinkeldein, D., Schoenduwe, R., Graff, A., Hoffmann, C., 2015. Who would use integrated sustainable mobility services-and why? Transport and Sustainability 7, 177–203. https://doi.org/10.1108/S2044-994120150000007019.
Hoerler, R., van Dijk, J., Patt, A., Del Duce, A., 2021. Carsharing experience fostering sustainable car purchasing? Investigating car size and powertrain choice. Transport. Res. Transport Environ. 96, 102861. https://doi.org/10.1016/j.trd.2021.102861.
Hossain, M.S., Kumar, L., Islam, M.M., Selvaraj, J., 2022a. A comprehensive review on the integration of electric vehicles for sustainable development. J. Adv. Transport. 1–26. https://doi.org/10.1155/2022/3868388.
Hossain, M., Akhter, F., Sultana, M.M., 2022b. SMEs in covid-19 crisis and combating strategies: a systematic literature review (SLR) and A case from emerging economy. Operations Research Perspectives 9, 100222. https://doi.org/10.1016/j.orp.2022.100222.
Jain, T., Rose, G., Johnson, M., 2021. "Don't you want the dream?": psycho-social determinants of car share adoption. Transport. Res. F Traffic Psychol. Behav. 78, 226–245. https://doi.org/10.1016/j.trf.2021.02.008.
Javid, R.J., Nejat, A., 2017. A comprehensive model of regional electric vehicle adoption and penetration. Transport Pol. 54, 30–42. https://doi.org/10.1016/j.tranpol.2016.11.003.
Jin, R., Chen, K., 2020. Impact of value cocreation on customer satisfaction and loyalty of online car-hailing services. JTAER 3 (16), 432–444. https://doi.org/10.3390/jtaer16030027.
Jonuschat, H., Stephan, K., Schelewsky, M., 2015. Understanding multimodal and intermodal mobility. Transport and Sustainability 7, 149–176. https://doi.org/10.1108/s2044-994120150000007018.
Julsrud, T.E., Farstad, E., 2020. Car sharing and transformations in households travel patterns: insights from emerging proto-practices in Norway. Energy Res. Social Sci. 66, 101497. https://doi.org/10.1016/j.erss.2020.101497.
Julsrud, T.E., Standal, K., 2023. Developing B2B electric car sharing as a sustainable mode of work travels. A community-based affordances perspective. International Journal of Sustainable Transportation 17 (7), 815–826. https://doi.org/10.1080/15568318.2022.2103858.
Jung, J., Koo, Y., 2018. Analyzing the effects of car sharing services on the reduction of greenhouse gas (GHG) emissions. Sustainability 10 (2), 539. https://doi.org/10.3390/su10020539.
Juschten, M., Ohnmacht, T., Thao, V.T., Gerike, R., Hössinger, R., 2019. Carsharing in Switzerland: identifying new markets by predicting membership based on data on supply and demand. Transportation 46, 1171–1194. https://doi.org/10.1007/s11116-017-9818-7.
Kandt, J., Rode, P., Hoffmann, C., Graff, A., Smith, D., 2015. Gauging interventions for sustainable travel: a comparative study of travel attitudes in Berlin and London. Transport. Res. Pol. Pract. 80, 35–48. https://doi.org/10.1016/j.tra.2015.07.008.
Kawgan-Kagan, I., 2015. Early adopters of carsharing with and without BEVs with respect to gender preferences. European Transport Research Review 7 (33). https://doi.org/10.1007/s12544-015-0183-3.
Keller, A., Aguilar, A., Hanss, D., 2018. Car sharers' interest in integrated multimodal mobility platforms: a diffusion of innovations perspective. Sustainability 10 (12), 4689. https://doi.org/10.3390/su10124689.
Kent, J.L., Dowling, R., 2013. Puncturing automobility? Carsharing practices. J. Transport Geogr. 32, 86–92. https://doi.org/10.1016/j.jtrangeo.2013.08.014.
Keyvanfar, A., Shafaghat, A., Muhammad, N., Ferwati, M., 2018. Driving behaviour and sustainable mobility—policies and approaches revisited. Sustainability 10 (4), 1152. https://doi.org/10.3390/su10041152.

Kim, D., Ko, J., Park, Y., 2015. Factors affecting electric vehicle sharing program participants' attitudes about car ownership and program participation. Transport. Res. Transport Environ. 36, 96–106. https://doi.org/10.1016/j.trd.2015.02.009.
Kim, J., Rasouli, S., Timmermans, H., 2017. Satisfaction and uncertainty in car-sharing decisions: an integration of hybrid choice and random regret-based models. Transport. Res. Pol. Pract. 95, 13–33. https://doi.org/10.1016/j.tra.2016.11.005.
Kosunda, S.E., Basciftci, B., Koca, E., 2023. Optimizing strategic and operational decisions of car sharing systems under demand uncertainty and substitution. https://doi.org/10.48550/arXiv.2307.
Kubera, M., Ślusarczyk, B., 2023. Carcrashing as an element of mobility management. Polish Journal of Management Studies 27 (2), 188–205. https://doi.org/10.17512/pjms.2023.27.2.12.
Le Boennec, R., Nicolaï, I., Da Costa, P., 2019. Assessing 50 innovative mobility offers in low-density areas: a French application using a two-step decision-aid method. Transport Pol. 83, 13–25. https://doi.org/10.1016/j.tranpol.2019.08.003.
Le Vine, S., Polak, J., 2019. The impact of free-floating carsharing on car ownership: early-stage findings from London. Transport Pol. 75, 119–127. https://doi.org/10.1016/j.tranpol.2017.02.004.
Lemme, R.F.F., Arruda, E.F., Bahiense, L., 2019. Optimization model to assess electric vehicles as an alternative for fleet composition in station-based car sharing systems. Transport. Res. Transport Environ. 67, 173–196. https://doi.org/10.1016/j.trd.2018.11.008.
Li, L., Zhang, Y., 2023. An extended theory of planned behavior to explain the intention to use carsharing: a multi-group analysis of different sociodemographic characteristics. Transportation 50 (1), 143–181. https://doi.org/10.1007/s11116-021-10240-1.
Lo, Franco, F., Cirimele, V., Ricco, M., Monteiro, V., Afonso, J.L., Grandi, G., 2022. Smart charging for electric car-sharing fleets based on charging duration forecasting and planning. Sustainability 14 (19). https://doi.org/10.3390/su141912077.
Loorbach, D., Schwanen, T., Doody, B.J., Arnfalk, P., Langeland, O., Farstad, E., 2021. Transition governance for just, sustainable urban mobility: an experimental approach from Rotterdam, The Netherlands. Journal of Urban Mobility 1, 100009. https://doi.org/10.1016/j.urbmob.2021.100009.
Luna, T.F., Uriona-Maldonado, M., Silva, M.E., Vaz, C.R., 2020. The influence of e-carsharing schemes on electric vehicle adoption and carbon emissions: an emerging economy study. Transport. Res. Transport Environ. 79, 102226. https://doi.org/10.1016/j.trd.2020.102226.
Ma, F., Guo, D., Yuen, K.F., Sun, Q., Ren, F., Xu, X., Zhao, C., 2020. The influence of continuous improvement of public car-sharing platforms on passenger loyalty: a mediation and moderation analysis. Int. J. Environ. Res. Publ. Health 17 (8), 2756. https://doi.org/10.3390/ijerph17082756.
Marx, R., Mello, A. M. de, Zilbovicius, M., Lara, F.F., 2014. Spatial contexts and firm strategies: applying the multilevel perspective to sustainable urban mobility transitions in Brazil. J. Clean. Prod. 108, 1092–1104. https://doi.org/10.1016/j.jclepro.2015.09.001.
Massaro, M., Dumay, J., Guthrie, J., 2016. On the shoulders of giants: undertaking a structured literature review in accounting. Account Audit. Account. J. 29 (5), 767–801. https://doi.org/10.1108/AAAJ-01-2015-1939.
Mattia, G., Guglielmetti Mugion, R., Principato, L., 2019. Shared mobility as a driver for sustainable consumptions: the intention to re-use free-floating car sharing. J. Clean. Prod. 237. https://doi.org/10.1016/j.jclepro.2019.06.235.
Mavlutova, I., Kuzmina, J., Uvarova, I., Atstaja, D., Lesinskis, K., Mikelsone, E., Brizga, J., 2021. Does car sharing contribute to urban sustainability from user-motivation perspectives? Sustainability 13 (19), 10588. https://doi.org/10.3390/su131910588.
McAuliffe Wells, E., Small, M., Spurlock, C.A., Wong-Parodi, G., 2021. Factors associated with emerging multimodal transportation behavior in the San Francisco Bay Area. Environ. Res.: Infrastructure and Sustainability 1 (3), 031004. https://doi.org/10.1088/2634-4505/ac392f.
Meisel, S., Merfeld, T., 2018. Economic incentives for the adoption of electric vehicles: a classification and review of e-vehicle services. Transport. Res. Transport Environ. 65, 264–287. https://doi.org/10.1016/j.trd.2018.08.014.
Meng, Z., Li, E.Y., Qiu, R., 2020. Environmental sustainability with free-floating carsharing services: an on-demand refueling recommendation system for Car2go in Seattle. Technol. Forecast. Soc. Change 152, 119893. https://doi.org/10.1016/j.techfore.2019.119893.
Merlin, L.A., 2017. Comparing automated shared taxis and conventional bus transit for a small city. Journal of Public Transportation 20 (2), 19–39. https://doi.org/10.5038/2375-0901.20.2.2.
Moro, S.R., Cauchick-Miguel, P.A., de Sousa-Zomer, T.T., de Sousa Mendes, G.H., 2023. Design of a sustainable electric vehicle sharing business model in the Brazilian context. International Journal of Industrial Engineering and Management 14 (2), 147–161. https://doi.org/10.24867/ijiem-2023-2-330.
Moscholidou, I., Pangbourne, K., 2020. A preliminary assessment of regulatory efforts to steer smart mobility in London and Seattle. Transport Pol. 98, 170–177. https://doi.org/10.1016/j.tranpol.2019.10.015.
Mouratidis, K., 2022. Bike-sharing, car-sharing, e-scooters, and Uber: who are the shared mobility users and where do they live? Sustain. Cities Soc. 86, 104161. https://doi.org/10.1016/j.scs.2022.104161.
Mugion, R.G., Toni, M., Raharjo, H., Di Pietro, L., Sebathu, S.P., 2018. Does the service quality of urban public transport enhance sustainable mobility? J. Clean. Prod. 174, 1566–1587. https://doi.org/10.1016/j.jclepro.2017.11.052.
Münzel, K., Piscicelli, L., Boon, W., Frenken, K., 2019. Different business models – different users? Uncovering the motives and characteristics of business-to-consumer and peer-to-peer carsharing adopters in The Netherlands. Transport. Res. Transport Environ. 73, 276–306. https://doi.org/10.1016/j.trd.2019.07.001.
Münzel, K., Boon, W., Frenken, K., Blomme, J., van der Linden, D., 2020. Explaining carsharing supply across Western European cities. International Journal of Sustainable Transportation 14 (4), 243–254. https://doi.org/10.1080/15568318.2018.1542756.
Nexus, C., 2022. Climate benefits of public transportation. https://climatenexus.org/climate-issues/energy/public-transit-climate-benefits/.
Noyons, E., 2001. Bibliometric mapping of science in a policy context. Scientometrics 50 (1), 83–98. https://doi.org/10.1023/a:1005694202977.
Ortega, A., Haq, G., Anastasios, T., 2023. Carsharing in Europe: a critical review of policy, research, innovation, and practice. Transport. Plann. Technol. 46 (4), 381–406. https://doi.org/10.1080/03081060.2023.2192195.
Pakusch, C., Stevens, G., Boden, A., Bossauer, P., 2018. Unintended effects of autonomous driving: a study on mobility preferences in the future. Sustainability 10 (7). https://doi.org/10.3390/su10072404.
Park, E., Kim, K.J., 2013. An integrated adoption model of mobile cloud services: exploration of key determinants and extension of technology acceptance model. Telematics Inf. 31, 376–385. https://doi.org/10.1016/j.tele.2013.11.008.
Paul, J., Criado, A.R., 2020. The art of writing literature review: what do we know and what do we need to know? Int. Bus. Rev. 29 (4), 101717. https://doi.org/10.1016/j.ibusrev.2020.101717.
Paul, J., Lim, W.M., O'Cass, A., Hao, A.W., Bresciani, S., 2021. Scientific procedures and rationales for systematic literature reviews (SPAR-4-SLR). Int. J. Consum. Stud. 45 (4), O1–O16. https://doi.org/10.1111/ijcs.12695.
Peltomaa, J., Tuominen, A., 2022. The orchestration of sustainable mobility service innovations: understanding the manifold agency of car sharing operators. J. Environ. Plann. Manag. 65 (4), 630–649. https://doi.org/10.1080/09640568.2021.1898352.
Perboli, G., Ferrero, F., Musso, S., Vesco, A., 2018. Business models and tariff simulation in car-sharing services. Transport. Res. Pol. Pract. 115, 32–48. https://doi.org/10.1016/j.tra.2017.09.011.
Poltimäe, H., Rehema, M., Raun, J., Poom, A., 2022. In search of sustainable and inclusive mobility solutions for rural areas. European Transport Research Review 14 (13). https://doi.org/10.1186/s12544-022-00536-3.
Quang, M.N., Rogers, T., Hofman, J., Lanham, A., 2019. New framework for automated article selection applied to a literature review of enhanced biological phosphorus removal. PLoS One 5 (14), e0216126. https://doi.org/10.1371/journal.pone.0216126.
Radianti, J., Majchrzak, T.A., Fromm, J., Wohlgenannt, I., 2020. A systematic review of immersive virtual reality applications for higher education: design elements, lessons learned, and research agenda. Comput. Educ. 147. https://doi.org/10.1016/j.compedu.2019.103778, 103778-103778.
Roblek, V., Meško, M., Podbregar, I., 2021. Impact of car sharing on urban. Sustainability 13 (2), 905. https://doi.org/10.3390/su13020905.
Rohde, G., Johannessen, B., Maaseide, M., Flateland, S.M., Skisland, A., Moi, E.B., et al., 2023. Being a nursing student during the coronavirus pandemic: a mixed methods study. BMC Nurs. 1 (22). https://doi.org/10.1186/s12912-023-01218-8.
Rokicki, T., Bórawski, P., Bełdycka-Bórawska, A., Żak, A., Koszela, G., 2021. Development of electromobility in European union countries under covid-19 conditions. Energies 1 (15), 9. https://doi.org/10.3390/en15010009.
Ruhrort, L., Steiner, J., Graff, A., Hinkeldein, D., Hoffmann, C., 2014. Carsharing with electric vehicles in the context of users' mobility needs - results from user-centred research from the BeMobility field trial (Berlin). Int. J. Automot. Technol. Manag. 14, 286–305. https://doi.org/10.1504/IJATM.2014.065294.
Safdar, M., Jamal, A., Al-Ahmadi, H.M., Rahman, M.T., Almoshaogeh, M., 2022. Analysis of the influential factors towards adoption of car-sharing: a case study of a megacity in a developing country. Sustainability 14 (5), 2778. https://doi.org/10.3390/su14052778.
Santos, G., Behrendt, H., Teytelboym, A., 2010. Part II: policy instruments for sustainable road transport. Res. Transport. Econ. 28 (1), 46–91. https://doi.org/10.1016/j.retrec.2010.03.002.
Santos, G., Maoh, H., Potoglou, D., von Brunn, T., 2013. Factors influencing modal split of commuting journeys in medium-size European cities. J. Transport Geogr. 30, 127–137. https://doi.org/10.1016/j.jtrangeo.2013.04.005.
Scarinci, R., Rast, F., Bierlaire, M., 2017. Needed reduction in mobility energy consumption to meet the goal of a 2000-watt society. Transport. Res. Pol. Pract. 101, 133–148. https://doi.org/10.1016/j.tra.2017.05.010.
Schwanen, T., 2015. Beyond instrument: smartphone app and sustainable mobility. Eur. J. Transport Infrastruct. Res. 15 (4), 675–690. https://doi.org/10.18757/ejtir.2015.15.4.3104.
Secinaro, S., Calandra, D., Lanzalonga, F., Ferraris, A., 2022. Electric vehicles' consumer behaviours: mapping the field and providing a research agenda. J. Bus. Res. 150, 399–416. https://doi.org/10.1016/j.jbusres.2022.06.011.
Seign, R., Schüßler, M., Bogenberger, K., 2015. Enabling sustainable transportation: the model-based determination of business/operating areas of free-floating carsharing systems. Res. Transport. Econ. 51, 104–114. https://doi.org/10.1016/j.retrec.2015.10.012.
Ševčenko-Kozlovska, G., Čižiūnienė, K., 2022. A study of the relationship between Lithuanian international migration flows and transport sector performance indicators. Sustainability 14 (16). https://doi.org/10.3390/su14169833.
Shah, K.J., Pan, S.-Y., Lee, I., Kim, H., You, Z., Zheng, J.-M., Chiang, P.-C., 2021. Green transportation for sustainability: review of current barriers, strategies, and innovative technologies. J. Clean. Prod. 326 (1), 129392. https://doi.org/10.1016/j.jclepro.2021.129392.
Shaheen, S.A., Mallery, M.A., Kingsley, K.J., 2012. Personal vehicle sharing services in North America. Research in Transportation Business and Management 3, 71–81. https://doi.org/10.1016/j.rtbm.2012.04.005.

Shams Esfandabadi, Z., Diana, M., Zanetti, M.C., 2022. Carsharing services in sustainable urban transport: an inclusive science map of the field. J. Clean. Prod. 357, 131981. https://doi.org/10.1016/j.jclepro.2022.131981.

Singh, Y.J., 2020. Is smart mobility also gender-smart? J. Gend. Stud. 29 (7), 832–846. https://doi.org/10.1080/09589236.2019.1650728.

So, J.J., Chae, M., Hong, J., Youm, J., Kim, S.H., Kim, J., 2023. Integrated mobility hub location selection for sustainable urban mobility. Sustain. Cities Soc. 99, 104950. https://doi.org/10.1016/j.scs.2023.104950.

Stewart, K., 2015. Assessing the carbon impact of ICT measures: a case study investigation using latis model. International Journal of Transportation Science and Technology 4 (3), 277–294. https://doi.org/10.1260/2046-0430.4.3.277.

Storme, T., Casier, C., Azadi, H., Witlox, F., 2021. Impact assessments of new mobility services: a critical review. Sustainability 13 (6), 3074. https://doi.org/10.3390/su13063074.

Svennevik, E.M.C., 2019. The existing and the emerging: car ownership and car sharing on the road towards sustainable mobility. Int. J. Automot. Technol. Manag. 19 (3/4), 281–300. https://doi.org/10.1504/ijatm.2019.10021998.

Sweet, M., Scott, D.M., 2024. Changes in emerging mobility tool adoption: a path towards sustainability? Transport. Res. Transport Environ. 127, 104056. https://doi.org/10.1016/j.trd.2024.104056.

Teles, F., Gomes Magri, R.T., Cooper Ordoñez, R.E., Anholon, R., Lacerda Costa, S., Santa-Eulalia, L.A., 2018. Sustainability measurement of product-service systems: Brazilian case studies about electric car-sharing. Int. J. Sustain. Dev. World Ecol. 25 (8), 722–729. https://doi.org/10.1080/13504509.2018.1488771.

Torrisi, V., Campisi, T., Ignaccolo, M., Inturri, G., Tesoriere, G., 2022. Assessing the propensity to car sharing services in university cities: some insights for developing the Co-creation process. Communications - Scientific Letters of the University of Zilina 24 (3), G1–G14. https://doi.org/10.26552/com.c.2022.3.g1-g14.

Tran, V., Zhao, S., Diop, E.B., Song, W., 2019. Travelers' acceptance of electric carsharing systems in developing countries: the case of China. Sustainability 11 (19). https://doi.org/10.3390/su11195348.

Tuominen, A., Rehunen, A., Peltomaa, J., Mäkinen, K., 2019. Facilitating practices for sustainable car sharing policies - an integrated approach utilizing user data, urban form variables and mobility patterns. Transp. Res. Interdiscip. Perspect. 2, 100055. https://doi.org/10.1016/j.trip.2019.100055.

Turoń, K., 2022. Open innovation business model as an opportunity to enhance the development of sustainable shared mobility industry. Journal of Open Innovation: Technology, Market, and Complexity 8 (1), 37. https://doi.org/10.3390/joitmc8010037.

Vătămănescu, E.M., Nicolescu, L., Gazzola, P., Amelio, S., 2023. Integrating smart mobility and electric car sharing adoption in a common framework: antecedents and mediators. J. Clean. Prod. 418, 138254. https://doi.org/10.1016/j.jclepro.2023.138254.

Vélez, A.M.A., 2023. Environmental impacts of shared mobility: a systematic literature review of life-cycle assessments focusing on car sharing, carpooling, bikesharing, scooters and moped sharing. https://doi.org/10.1080/01441647.2023.2259104.

Wang, N., Guo, J., Liu, X., Fang, T., 2020. A service demand forecasting model for one-way electric car-sharing systems combining long short-term memory networks with Granger causality test. J. Clean. Prod. 244, 118812. https://doi.org/10.1016/j.jclepro.2019.118812.

Wang, N., Jia, S., Liu, Q., 2021. A user-based relocation model for one-way electric carsharing system based on micro demand prediction and multi-objective optimization. J. Clean. Prod. 296, 126485. https://doi.org/10.1016/j.jclepro.2021.126485.

Wang, J., Dane, G.Z., Timmermans, H.J.P., 2021a. Carsharing-facilitating neighbourhood choice: a mixed logit model. J. Hous. Built Environ. 36, 1033–1054. https://doi.org/10.1007/s10901-020-09791-z.

Wang, J., Dane, G., Timmermans, H., 2021b. Individuals who have zero-interest in living in carsharing-facilitating neighbourhoods: a case study in The Netherlands. Eur. Plann. Stud. 29 (12), 2209–2225. https://doi.org/10.1080/09654313.2021.1903840.

Wilbur, M., Sivagnanam, A., Ayman, A., Samaranayeke, S., Dubey, A., Laszka, A., 2023. Artificial intelligence for smart transportation. https://export.arxiv.org/pdf/2308.07457v1.pdf.

Willing, C., Brandt, T., Neumann, D., 2017. Electronic mobility market platforms – a review of the current state and applications of business analytics. Electron. Mark. 27, 267–282. https://doi.org/10.1007/s12525-017-0257-2.

Wong, Y.Z., Hensher, D.A., 2021. Delivering mobility as a service (MaaS) through a broker/aggregator business model. Transportation 48, 1837–1863. https://doi.org/10.1007/s11116-020-10113-z.

Xidias, E.K., Panagiotopoulos, I.E., Zacharia, P. Th, 2023. An intelligent management system for relocating semi-autonomous shared vehicles. Transport. Plann. Technol. 46 (1), 93–118. https://doi.org/10.1080/03081060.2022.2162052.

Yun, J.J., Zhao, X., Wu, J., Yi, J.S., Park, K., Jung, W., 2020. Business model, open innovation, and sustainability in car sharing industry - comparing three economies. Sustainability 5 (12), 1883. https://doi.org/10.3390/su12051883.

Zhang, R., Zhang, J., 2021. Long-term pathways to deep decarbonization of the transport sector in the post-COVID world. Transport Pol. 110, 28–36. https://doi.org/10.1016/j.tranpol.2021.05.018.

Zhu, J., Xie, N., Cai, Z., Tang, W., Chen, X., 2023. A comprehensive review of shared mobility for sustainable transportation systems. International Journal of Sustainable Transportation 17 (5), 527–555. https://doi.org/10.1080/15568318.2022.2054390.

Zupic, I., Čater, T., 2015. Bibliometric methods in management and organization. Organ. Res. Methods 18 (3), 429–472.