



The governance of dockless bike-sharing schemes: A systemic review of peer-reviewed academic journal papers between 2016 and 2019

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ABSTRACT

Since dockless bicycle-sharing systems (DBSS) first arose in China in 2016, studies have examined their governance. However, there has been no comprehensive review of the literature on DBSS. This paper presents the first systematic review of the burgeoning literature on the governance of DBSS. It maps key research themes, identifies research trends and provides a deeper understanding of the governance literature on DBSS. We searched the Web of Science (WoS), Scopus and China National Knowledge Infrastructure (CNKI) databases to identify 95 papers written in English or Chinese between 2016 and 2019 that address the governance of DBSS. A thematic coding of these papers was supported by bibliometric analysis and knowledge mapping using the VOSviewer. More papers are written in Chinese rather than English, focusing on Chinese cities. Although the time range of our literature search was between 2016 and 2019, the first paper was published in 2017. Four key themes in the governance of DBSSs were identified within the papers, and over time the papers shifted their focus from problem-finding and problem-defining to problem-solving. Discussion of the inherent characteristics of the sharing economy and the externalities underpinning the governance of DBSS (Theme 1) and rebalancing problems for DBSS (Theme 2) first arose in early 2017, whilst discussions of the government regulation of DBSS (Themes 3) and the cross-boundary governance models underpinning DBSS (Themes 4) first arose in mid-2017. This paper concludes with a discussion of the identified themes and trends in the context of the broader literature on bicycle sharing and identifies opportunities for further research.

1. Introduction

In recent decades there has been an increased focus on the development of socially, economically and environmentally sustainable transport systems that can help tackle climate change, create liveable places, reduce congestion and pollution, and support the better health and wellbeing of communities (Shi et al., 2018). As part of this focus academic literature is paying increasing attention to bicycle-sharing systems (BSS) (Guo et al., 2017), which have been identified as a sustainable transport strategy that is contributing to the transformation of urban transport systems across the world (Ma et al., 2018).

BSS generally refers to companies and/or governments providing access to bicycle-sharing services in urban public spaces (Jiang and Cai, 2017) which can be used instead of, or to supplement, cars, buses, trains, and walking (Mateo-Babiano et al., 2017). BSS has evolved from 'dockless' to 'docked' and back to 'dockless' (Wang et al., 2019). First-generation BSS saw the emergence of "White Bikes" in Amsterdam in 1965. They could be taken anywhere and left unlocked for the next

user. The service was discontinued after bicycles were thrown into canals or stolen (DeMaio, 2009). In 1991 that the second generation of BSS, "City Bikes", arose in Denmark (Yu et al., 2019). Key features of second-generation BSS were fixed docking stations and coin access. This was an improvement, but this form of BSS was still vulnerable to theft due to the anonymity of users (Mateo-Babiano et al., 2017). The third generation BSS, called "Vélos à la carte", was launched in 1998 in France. It was also a docked system, but it replaced coin access with smart card access so that bicycle users could be traced, and in 2005, it further improved the tracking of bicycles through the use of global positioning systems (GPS). Due to the constraints caused by fixed docking stations, usage rates for third-generation BSS were low (Shi et al., 2018).

The fourth-generation BSS, which is the focus of this review, emerged in China in 2016 (Shi et al., 2018). This system was dockless but retained the use of smart card access (linked to smart phones) and GPS to track bicycles. This fourth-generation BSS has been called: Dockless BSS (Sun, 2018), Stationless BSS (Heymes, 2019), Station-free

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BSS (Z. Gu et al., 2019), and Free-floating BSS (Ma et al., 2018). We use the term Dockless BSS (DBSS). DBSS is arguably more flexible and cheaper than its predecessors, and it provides easier access (Sun, 2018) because bicycles can be unlocked and paid for using a smartphone and can be picked up and left anywhere (Jia et al., 2018). Since 2016, DBSS companies, including Ofo and Mobike, have launched DBSS in cities throughout the world (Wang, 2017). Mobike's website indicates that it currently provides DBSS for more than 200 million users in over 200 cities in 20 countries.

The systematic review of the burgeoning peer-reviewed literature on DBSS presented within this paper is unique in two ways. Firstly, whilst prior reviews focused on various aspects of BSS, including users' travel behaviour (Fishman, 2016), user experience (Fishman et al., 2013), and relevant socio-economic impacts (Si et al., 2019), this is the first systematic literature review to focus on the governance-related issues of DBSS. Effective governance has been identified as a key dimension of the sustainability of DBSS (Ma et al., 2018), and BSS more broadly (Ricci, 2015). The review maps key research themes, identifies research trends, and provides a deeper understanding of the governance literature on DBSS. Secondly, whilst prior reviews have focused exclusively on English literature, this is the first review of both English and Chinese literature on DBSS. This is important given that DBSS first emerged in China (Du and Cheng, 2018). The review examines published peer-reviewed academic journal papers written on the governance of DBSS in both English and Chinese between 1 January 2016 and 31 December 2019.

This paper begins with an outline of its systematic approach (Section 2), then presents an overview of the literature and the key themes on governance (Section 3). It then discusses these key themes in relation to earlier BSS literature reviews (Section 4) and concludes by providing policy recommendations and identifying gaps within the literature and possible directions for future research on the governance of DBSS (Section 5).

2. Method

2.1. Search strategy

A literature search was carried out using three databases: Web of Science (WoS), Scopus and China National Knowledge Infrastructure (CNKI) for papers published between 1 January 2016 and 31 December 2019.

2.2. Search terms

Search terms were used in combination with the Boolean operators "AND", "OR" and "NOT", which allowed the researchers to combine search concepts and synonyms or eliminate terms. Truncated symbols were also used to include all words starting with the same order of letters, for example the symbol * means other forms of the keyword, such as "bicycle" and "bicycles". The searches in WoS and Scopus were performed using different terms to name the bicycle-sharing system: "TS= ("bicycle sharing" OR "sharing bicycle" OR "bicycle sharing" OR "bicycle share*" OR "shared bicycle*" OR "bicycle-sharing" OR "shared bicycle*" OR "free floating bicycle sharing*" OR "dockless bicycle sharing*" OR "station-less bicycle sharing*" OR "station-free bicycle sharing*"). These keywords were translated into Chinese for use in CNKI's search system.

2.3. Inclusion criteria

Papers were reviewed if they were: (a) peer-reviewed academic journal papers, (b) written in English or Chinese, (c) published between 1 January 2016 and 31 December 2019, and (d) related to DBSS governance (e.g., governance issues, governance modes, policies, laws, institutions, cross-boundary collaborations and rebalancing).

2.4. Exclusion criteria

The following were excluded from the review: (a) conference papers, book chapters, editorial material, reports and grey literature (e.g., theses, meeting abstracts and retracted publications), (b) duplicates of prior studies, (c) papers which focused on docked BSS, and (d) papers which did not address the governance of DBSS.

2.5. Review procedure

A researcher, with verification from a second researcher, assessed the eligibility of studies. The review procedure is summarized in Fig. 1. Firstly, WoS (n = 213), Scopus (n = 925) and CNKI (n = 336) searches were performed, and all titles and abstracts were scanned for the presence of inclusion and exclusion criteria. When a decision could not be made based on a paper's abstract, the full text was reviewed. Where duplicate papers were identified, only the earliest paper was retained. This first step yielded 87 papers (33 from WoS, 3 from Scopus and 51 from CNKI).

In the second step, backward snowballing was performed on the reference lists of the 87 papers identified in step 1 to identify additional papers. Through this process, 1319 full texts had to be further examined for possible inclusion. We read the abstracts and the full texts of these papers to determine whether they met all the inclusion criteria discussed above. This yielded 8 additional papers (3 in English and 5 in Chinese) for a total of 95 papers (39 in English and 56 in Chinese).

The final step involved identifying key themes on the governance of DBSS within the 95 papers (see Table 1). All papers were thematically coded (Gibbs, 2007). Coding involved one researcher reading all papers in their entirety to identify passages or images that were linked by a common theme related to the governance of DBSS. The identified themes were verified by a second researcher. Two other analytical tools were used to help identify key themes:

- The bibliometric visualization analysis tools in the WoS, Scopus and CNKI databases were used to provide an overview of the research situation, such as countries and disciplines.
- A knowledge map of authors' keywords within the papers was developed using VOSviewer.

3. Results

3.1. Overview of DBSS literature on governance

Whilst the time range of our literature search was 1 January 2016 to 31 December 2019, no literature was found for 2016. The first paper (Guo et al., 2017) was published in mid-2017. We found more papers written in Chinese (n = 56) than in English (n = 39). The authors of the 95 papers came from 12 countries and regions: China (n = 88), USA (n = 7), UK (n = 6), France (n = 3), South Korea (n = 2), Netherlands (n = 2), Australia (n = 2), Germany (n = 1), Denmark (n = 1), Iran (n = 1), Italy (n = 1), and Taiwan (n = 1). Most papers (n = 88) focus on DBSS in Chinese cities. Only a few (n = 7) discuss DBSS in cities outside China, including Seoul, Paris and Seattle.

Four key themes related to governance were identified. Theme 1 is the characteristics of the sharing economy and the externalities that underpin the governance of DBSS. Theme 2 is rebalancing strategies for DBSS. Theme 3 is the government regulation of DBSS, and Theme 4 is the use of governance models to explain DBSS (see Table 1). Within the 95 papers, discussion of the economic models, property rights and externalities underpinning DBSS, and rebalancing strategies (Themes 1 and 2) first arose in the first half of 2017, whilst discussions of the challenges of government and legal regulation, and the governance models underpinning DBSS (Themes 3 and 4), first arose in the second half of 2017. The number of papers addressing Theme 4 increased rapidly in 2018 (see Fig. 2). Key concepts in each theme are listed in

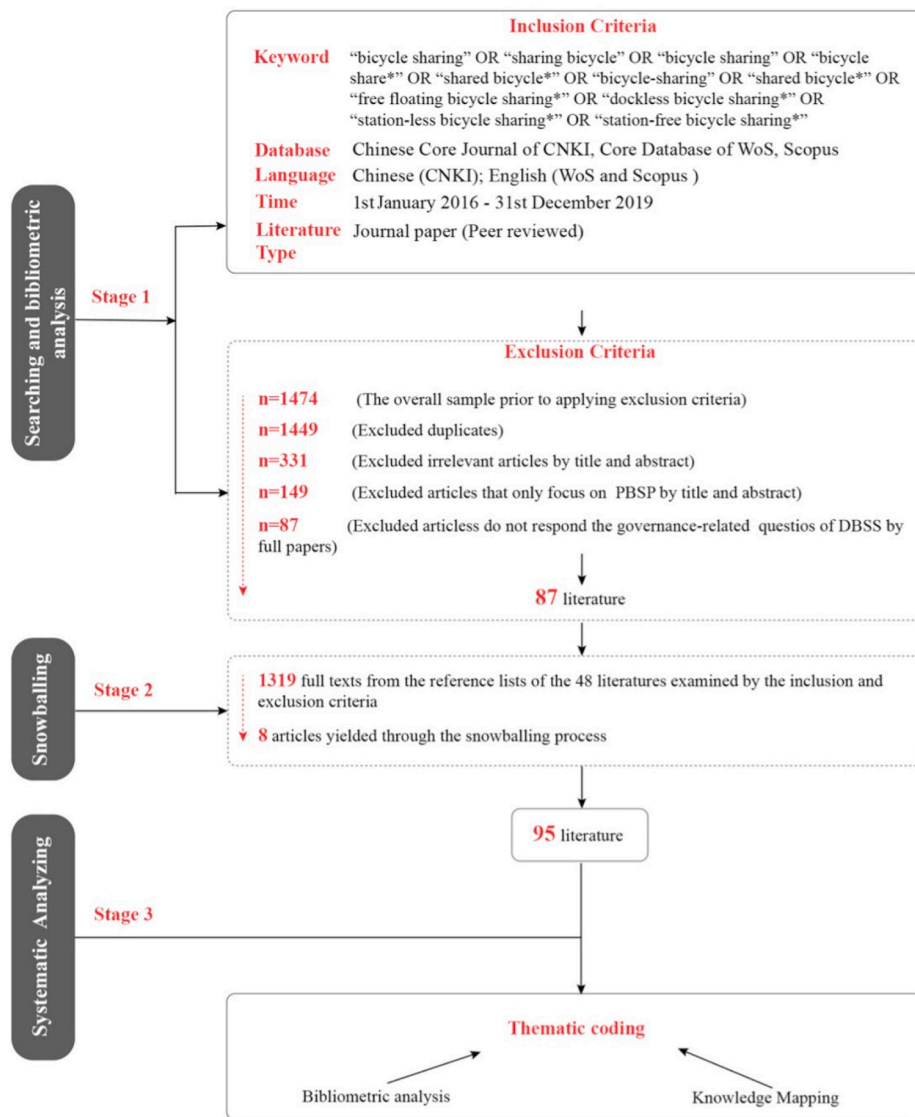


Fig. 1. The review procedure.

Table 1, and an overview of each of the 95 selected papers is provided in Appendix 1.

The 95 papers came from a range of disciplines: public management (n = 35), transport (n = 32), business (n = 14), environmental science (n = 12), law (n = 7), policy research (n = 4), green sustainable science technology (n = 2), energy (n = 1), regional urban planning (n = 1) and geography (n = 1). Discussion of the sharing economy and its externalities (Theme 1) was most prevalent in the field of economy. Discussion of rebalancing problems associated with DBSS (Theme 2) was most prevalent in the transport studies. Discussion of the challenge of DBSS to traditional government and the rise of DBSS governance (Themes 3 and 4) was most prevalent in the public management and policy research papers, but they were also discussed in some engineering, environmental science and geography papers.

3.2. Theme 1: the inherent characteristics of the sharing economy and its externalities underpinning the governance of DBSS

An early and ongoing theme discussed in 28 of the 95 papers was the inherent characteristics and externalities of DBSS which underpin the governance of DBSS, and the impacts these characteristics may have, for the titles of papers discussed in Theme 1, see Appendix 1.

25 of the 28 papers that discuss Theme 1 argue that DBSS is part of the sharing economy. The sharing economy is broadly defined as including the customer-to-customer (C2C) model and the business-to-customer (B2C) model (Zhu and She, 2017). In these papers the sharing economy associated with DBSS, whether C2C and B2C, is generally understood as an example of a new economic model created by the sharing of social and public services. This involves a shift from ownership to accessibility, or from possession to use, and the result is collaborative consumption in which "mine is yours, and yours is mine" (Felson and Spaeth, 1978, cited by Han and Chen, 2019). However, few papers argue that DBSS is not part of the sharing economy and could more accurately be described as "atypical-sharing" (Wang and He, 2017), or "pseudo-sharing" (Han and Chen, 2019). This is based on the view that the sharing economy involves the exchange of idle resources between customers, and shared bicycles are produced in response to user demand (Han and Chen, 2019). This view argues that DBSS is equivalent to traditional short-term rental, except in its use of internet technology to enable "intelligent rental". Zhu and She (2017) has criticized this view as involving a narrow understanding of the sharing economy. Although DBSS is not the sharing of idle resources, as the right of use is shared by many, it still largely falls into the category of a sharing economy.

Table 1
Key themes and associated keywords.

No	Theme	Number of high frequency keywords addressing each theme	High frequency keywords included in each theme
1	The inherent characteristics of the sharing economy and its externalities underpinning the governance of DBSS	64	Sharing economy (25), sustainability (6), value co-creation (5), internet finance (3), green mobility (3), urban traffic (2), supply side (2), oversupply (2), negative externality (2), disorderly parking (2), business operating model (2), quasi-public goods (2), market failure (4), misbehaviour (4)
2	Rebalancing strategies for DBSS	45	Rebalancing (14), vehicle routing problem (4), big data (6), deep learning (3), Markov chain (2), dynamic bicycle rebalancing (3), spatial temporary patterns (4), user-based rebalancing (3), genetic algorithm (2), demand driven (2), forecasting (2)
3	The government regulation of DBSS	35	Government regulation (10), policy (5), fragmented government (2), legislation (5), government dilemma (2), credit system (2), institution innovation (3), public service (3), self-control (2)
4	The cross-boundary collaboration in the governance of DBSS	28	Collaborative governance (19), stakeholder (2), social governance (5), intelligent governance (2)

The aforementioned characteristics of DBSS led to changes to property rights structures, and separated ownership and accessibility (Ma et al., 2019). DBSS companies retain ownership of the bicycles, and enable different users to transfer the right to use a bicycle at different times with almost zero marginal cost (Leng and Guo, 2018). These unique property rights led to a further discussion on the economic attributes of DBSS. In public goods theory, goods available for non-exclusive, non-competitive consumption are defined as public goods (Cowen, 1985, cited by Zhao et al., 2019). Goods with only one of the characteristics of public goods are referred to as quasi-public goods. DBSS cannot produce crowding effects and are endowed with non-competitiveness. However, whilst the bicycles are accessible to the public, this accessibility is not free (Gan and Lou, 2018). Jiang and Cai (2017) thus argue that DBSS provide a ‘quasi-public good’ with utility exclusiveness and non-consumer competitiveness. A few papers argue this description is inaccurate because DBSS exclude people who don’t want to pay (Leng and Guo, 2018) and are highly competitive in places where demand is high (e.g., bus stations, subway stations, and residential areas) and during high-demand periods (Han and Chen, 2019). Hence, the attributes of DBSS are hard to encapsulate using traditional public good theory because these attributes change due to spatiotemporal factors (Deng and Li, 2017).

Due to the transferability of disposal rights and its homological demands, DBSS has the nature of the tragedy of the commons (Hardin, 1968): Things shared by many people are largely unprotected and are

Table 2
Key modelling techniques used to forecast the spatiotemporal distribution of DBSS in selected papers.

Modelling techniques	Research aims	Location of the study	Papers
Regional extraction	Analysing spatiotemporal distribution	Shanghai	Xie et al. (2019)
Least-squares boosting	Predicting the number of available bicycles with related variables: the built environment, time effects, and weather conditions.	San Francisco	Ashqar et al. (2017)
Random Forest algorithm	Discovering spatiotemporal usage patterns	Shanghai; San Francisco	Du et al. (2019); Ashqar et al. (2017)
Partial Least-Squares Regression	Predicting the number of available bicycles with related variables: the built environment, time effects, and weather conditions.	San Francisco	Ashqar et al. (2017)
Markov chain	Forecasting the riding transfer rate of bicycles between stations and the optimal fleet size in each virtual station	None	Yan and Liu (2019); Zhai et al. (2019)
Long short-term memory neural network	Analysing the spatiotemporal distribution and trip pattern of users	Chengdu; Nanjing	Ai et al. (2019); Xu et al. (2018)
Statistical physics method	Dynamic evolution of demand fluctuation	Nanjing	Tian et al. (2019)
Zero-inflated negative binomial model	Analysing the influence of built environment on DBSS	Nanjing	Zhao et al. (2019)
Heuristic bicycle optimization algorithm	Analysing the usage efficiency problem	Shenzhen	Gu et al. (2019b)
Artificial neural networks	Forecasting the number and location of bicycles over a DBSS operating area	Beijing	Caggiani et al. (2018); Thi Hoai Thu et al. (2017)
Weighted K-Nearest-Neighbor	Predicting bicycle demand	New York City	Thi Hoai Thu et al. (2017)

likely to be damaged (Tan, 2017). Seven of the 28 papers discuss the negative externalities of DBSS. There are two main types of negative externalities: those associated with the operators and those associated with the users. The former refers to the waste and idleness of resources caused by DBSS companies attempting to expand their market share by flooding urban spaces with more and more bicycles. This strategy is often referred to as “burn money” (Zheng and Li, 2018). It leads to an oversupply of bicycles and congestion of urban spaces (Ma et al., 2018). The latter refers to the misuse of bicycles, which produces a negative image of the service. These negative externalities are associated with the impact that bicycles have on others when, for example, in Chinese cities, if the fleet size is large, users park bicycles haphazardly and block roadways (Yao et al., 2019). In cities outside China (e.g., Paris, Brussels, Dallas, Seattle) vandalism and theft are the most serious problems (Hauf and Douma, 2019). Some people have stolen parts from shared bicycles or even locked shared bicycles and claimed them as their own (Chen, 2019). Another commonly discussed negative externality is the ‘unbalanced’ spatiotemporal distribution of bicycles which requires heavy rebalancing work. This increases operating costs and truck usage. Bicycle rebalancing causes many car accidents which could offset the benefits of DBSS and intensify traffic congestion (Ban and Hyan, 2019). In China, the annual rebalancing costs of Ofo and Mobike are RMB 400 million yuan and 500 million yuan respectively (Nie and Zhang, 2018).

Seven of the 28 papers argue that DBSS provides a number of positive externalities. According to these papers, the positive effects of DBSS include: Firstly, the “supplement effect” (Qiu and He, 2018). DBSS is a

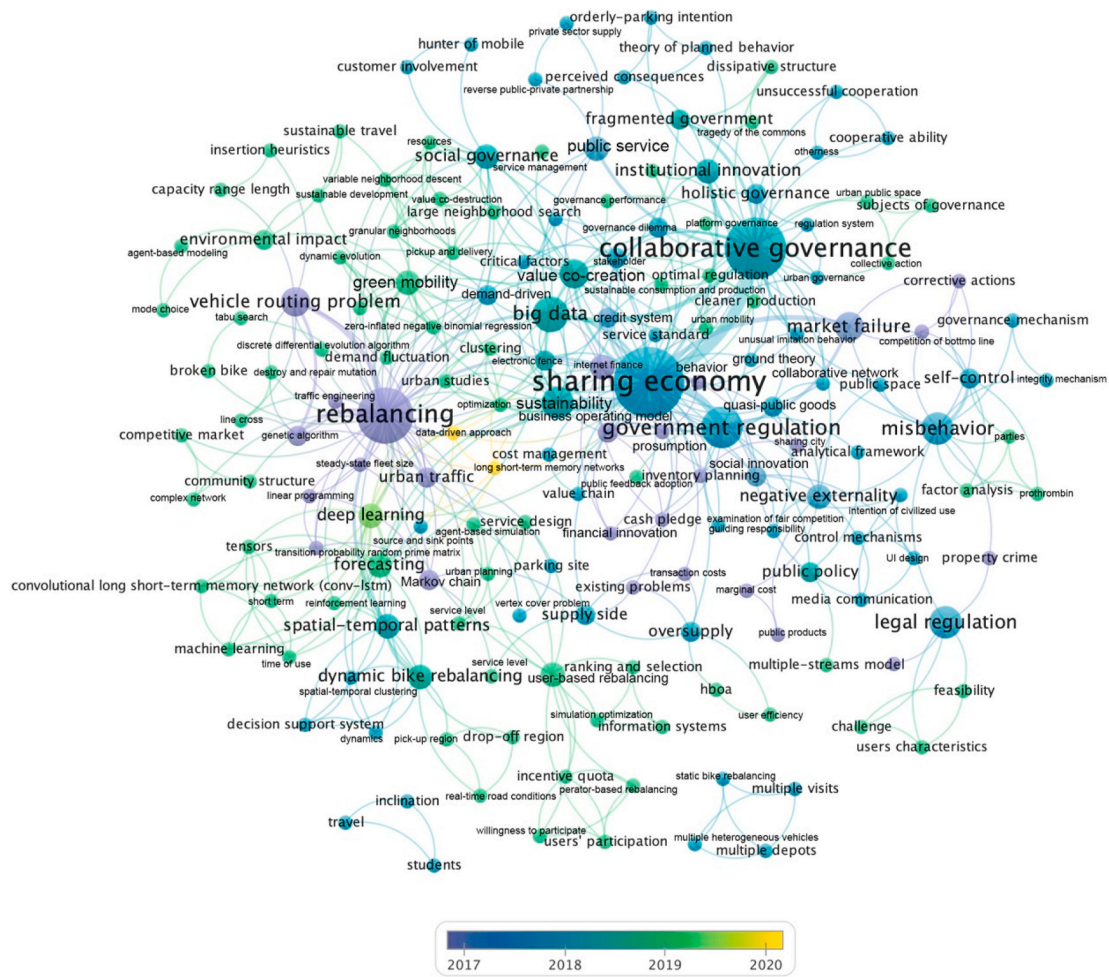


Fig. 2. Visualization of key concepts arising in the 95 papers over time (This diagram highlights all keywords in the 95 papers selected for this study. The scale of key concept nodes in the diagram is representative of the number of papers that address that keyword. See Table 1 for details on how many papers addressed each high-frequency keyword).

convenient tool to address the “last mile” and “first mile” problem of public transportation (Weng, 2018). DBSS integrates with and extends current urban public transport modes. The ‘bicycle + bus/metro + bicycle’ trip is seen as improving the efficiency of urban transport systems (Sun, 2018). Secondly, through the “substitution effect” (Qiu and He, 2018), DBSS can partly replace travel modes that create heavy pollution and energy consumption (Weng, 2018), and contributes to efforts to conserve energy and reduce air pollution, noise pollution and carbon emissions (Shi et al., 2018). In Shanghai, the DBSS saved 8358 tons of petrol and reduced CO2 emissions by 25,240 tons in 2016 (Wu et al., 2019). Moreover, although rebalancing work intensifies traffic congestion, DBSS helps alleviate traffic congestion through mode transfer from cars to bicycles (Yao et al., 2019). Thirdly, through the “health effect” (Qiu and He, 2018), DBSS promotes sustainable living (Shi et al., 2018).

3.3. Theme 2: rebalancing strategies for DBSS

Over a quarter of the papers (27 of 95) discuss rebalancing strategies, with a focus on how DBSS companies can improve efficiency by providing bicycles to meet user demand at the lowest operational cost, for the titles of papers discussed in Theme 2, see Appendix 1. Discussion of rebalancing strategies generally focuses on two issues: forecasting the spatiotemporal distribution of bicycles and user demand; and the optimization of rebalancing strategies.

Most of the papers (16 of 27) that discuss rebalancing strategies argue that their efficiency depends on the accurate forecasting of

dynamic demand. The aim of these forecasting processes, which often use mathematical modelling (Liu and Pan, 2019), is to predict how many parking slots should be planned and how many bicycles should be at each slot (Jie et al., 2020). Various modelling techniques have been used to forecast the spatiotemporal distribution of bicycles and user demand in Chinese and US cities (Table 2). Despite the complexities involved, these papers identify several characteristics that generally guide rebalancing strategies (see Table 3).

Some papers focus on comparing the accuracy of different regression models. Ashqar et al. (2017) suggest that univariate models (e.g., Random Forest or RF) are the most accurate because they construct a multitude of decision trees using bootstrap samples and calculate the mean of the predictions of the individual trees. Unlike static and linear techniques (e.g., linear discriminant analysis and logistic regression), RF can model complex interactions between predictor variables automatically (Ashqar et al., 2017). The other paper (Thi Hoai Thu et al., 2017) compared the accuracy of Similarity Weighted K Nearest Neighbor-based (SWK-based) regression and ANN-based prediction by testing the BSS of New York City. They found that the ANN achieved higher accuracy. However, Xu et al. (2018) argue that the ANN cannot fully capture the characteristics of time-series data as it does not account for temporal dependencies. Researchers have proposed using feed-forward deep neural networks. However, although recurrent neural networks (RNN) can account for temporal dependencies and predict time-series data, they are not suitable for use with time-series data with very long-time lags (Hochreiter and Schmidhuber, 1997). Moreover,

Table 3
Key characteristics of the spatiotemporal distribution of DBSS and user demand.

	Characteristics	Location of the study	Papers
The characteristics of spatiotemporal distribution	Maximum travel distances and travel times are in the morning rush hour (7:00–10:00), noon rush hour (11:00–13:00) and evening rush hour (17:00–18:00).	Chengdu; Nanjing; Beijing; Shanghai	Ai et al. (2019); Du and Cheng (2018); Gao and Li (2018); C. Xu et al. (2018); Zhao et al. (2019)
	The usage of bicycles on weekdays is higher than weekends.	Beijing	Gao and Li (2018)
	During the morning weekday rush hours, bicycles mostly travel from residential areas to business office and education areas, but the opposite is true during evening rush hours. On weekends, bikes mostly travel from residential areas to public leisure areas, with little difference between the morning and evening.	Beijing	Gao and Li (2018)
The characteristics of users' demand	Bicycles are usually distributed in urban central areas, but almost no bicycles are available in suburban areas which also have a high demand.	Shanghai	Jie et al. (2020)
	Bicycles are usually oversupplied in residential areas, transport stations, business offices, etc., but the number of bicycles near industrial buildings, entertainment facilities, hotels, etc. cannot meet demand.	Chengdu; Beijing; Shenzhen; Shanghai	Ai et al. (2019); Gao and Li (2018); Z. Gu et al. (2019); Jie et al. (2020); Zhao et al. (2019)
	Usually, residential areas have the highest user demand, followed by industrial areas, public transport stations, business offices and commercial areas.	Chengdu; Nanjing	Ai et al. (2019); Du and Cheng (2018)
	Whether it's a working day or non-working day, industrial buildings, metro stations, municipal utilities, and railway land always have high user demand	Beijing; Shenzhen	Gao and Li (2018); Z. Gu et al. (2019)

with RNNs it is hard to find the optimal window size for modelling time-series data, as they rely on predetermined time lags for temporal sequence processing (Xu et al., 2019). Xu et al. (2018) thus propose using long short-term memory neural networks (LSTM NN) to fit the time-series data of DBSS. Comparison findings indicate the LSTM NN achieved higher accuracy than both conventional statistical models and advanced machine learning methods for different time intervals (Xu et al., 2018).

18 of the 27 papers examining rebalancing strategies argue that strategies in cities all over the world (e.g., Beijing, Shanghai, Singapore,

Seoul) are either operator-based (15 of 18) or user-based (3 of 18). In operator-based strategies, rebalancing is performed by company staff and trucks (Guan and Lu, 2019); in user-based strategies, users receive monetary incentives to leave bicycles at locations where they are needed (Ban and Hyun, 2019). Research highlights inefficiencies and challenges in both types of strategies. The use of incentives in user-based strategies is challenging during peak times as self-rebalancing by users is time-consuming (Zhai et al., 2019). Moreover, the reward station is often too far from the user's original target station, and the small reward is not sufficient incentive (Yi et al., 2019). Operator-based strategies were found to have low efficiency and are sometimes time-consuming due to traffic congestion (Ban and Hyun, 2019). Given these inefficiencies and challenges, researchers have recently suggested a hybrid strategy which avoids the weaknesses of both strategies (Mahmoodian et al., 2019).

Operator-based strategies were further broken down into static approaches (8 of 15) and dynamic approaches (5 of 15), and two papers did not state which approach they focused on. Static approaches are used when user intervention is negligible (e.g., at night when demand is low). Dynamic approaches are used when the DBSS is active which consider the real-time usage of bicycles (Caggiani et al., 2018). Until recently the dynamic approach has had limited implementation because of its complexity and high implementation costs and has been generally restricted to large-scale DBSS programs during peak times (Lahoorpoor et al., 2019). However, it is increasingly being used because static strategies lack the flexibility needed to provide timely rebalancing (He et al., 2019). Moreover, researchers argue that DBSS is better suited to dynamic rebalancing because: the size of DBSS fleets is larger than docked BSS (Z. Gu et al., 2019); and DBSS bicycles are scattered across the urban space more broadly than in earlier docked BSS (Caggiani et al., 2018).

3.4. Theme 3: the government regulation of DBSS

To address negative externalities of public services, the traditional way is for the local government to issue and enforce top-down rules (Chen, 2019). Many papers (27 of 95) discuss the emerging role of government in the regulation of DBSS, for the titles of papers included in Theme 3, see Appendix 1. A key focus in these papers is regulation in China, Australia, Europe and North America by local governments. However, in most cases, top-down government modes have failed to regulate DBSS effectively.

In Chinese cities, three major issues emerged post-launch. Firstly, the lack of government functions in the early stages of DBSS (Weng, 2018). According to Fishman (2016), DBSS companies initiated almost no communication with China's local governments (regional/city) prior to launching their services, which meant China's local governments had only a limited understanding of DBSS, and they also lacked policy and legal support from provincial and central governments. Consequently, many of China's local governments took a neutral stance to DBSS when it first appeared in 2016 (Chen, 2019), which led to a lag in DBSS regulation by local governments (Cheng and Qi, 2018). This gave rise to the second issue: subordinate government departments don't know who should be responsible for DBSS regulations (Song, 2017), and they have been plagued by ambiguity and the overlap of regulatory functions, and the 'buck-passing' of responsibilities between authorities (Weng, 2018). Thus, the regulation of DBSS is inefficient and often contradictory in China (Yue and Hu, 2019). For example, in Shanghai, although the municipal government has delimited prohibited parking areas for DBSS, different government agencies have different views on where bicycles can legally be parked (Weng, 2018).

In August 2017, China's Central Government drafted the first national framework for DBSS regulation. It defines the responsibilities of government agencies and the obligations of operators and users and proposes several principles to regulate DBSS. However, according to several papers (Fan, 2018) the national guideline is imperfect and

remains at the macro level, and lacks practical approaches for DBSS regulation at the local level. The third issue is that a unified management standard (Fan, 2018), and authority for local governments to regulate DBSS (Chen and Wang, 2018), are still missing. Thus, although the Central Government guidelines were followed by the release of DBSS guidelines in many China's major cities (Chen, 2019), the regulation of DBSS by China's local governments has been fragmented (Li and Han, 2018). Each city or even districts within cities have their own regulations, and different local regulations include different management standards and rules (Gu et al., 2019a).

Outside China, DBSS companies tend to consult with local governments, sign a memorandum or initiate a pilot project prior to the launch of services (Hauf and Douma, 2019). Sometimes the major issue in cities outside China is that local governments tend to use "one-size-fits-all" approaches. They either ban DBSS services, as Amsterdam, Manchester and London did in 2017, or take a tough stance towards DBSS, as Melbourne and Dallas did. In Melbourne, the council imposed a fine of AUD \$3000 every time a DBSS company failed to take away dumped bicycles within 24 h. As a result, some companies such as oBike withdrew (Chen, 2019). Unfortunately, misbehaviour by users and operators still occurs frequently. The "patchwork" regulation issue in China's cities has also existed in San Diego and Boston (Hauf and Douma, 2019) and in Greater Sydney (Chen, 2019) where fragmentation means DBSS regulation across local government boundaries in challenging.

3.5. Theme 4: the cross-boundary collaboration in the governance of DBSS

Many papers (23 of 95) discuss the role of cross-boundary governance involving all levels of government, industry and society, in the regulation, management and operation of DBSS in Chinese cities, including first-tier cities such as Beijing, Shanghai and Guangzhou, but also provincial capitals such as Hangzhou and Wuhan and Nanjing, for the titles of papers discussed in Theme 4, see Appendix 1. Whilst most (16 of 23) of these papers explore DBSS within these cities through the conceptual lens of 'collaborative governance', other papers (7 of 23) apply other conceptual lenses including 'holistic governance', 'intelligent governance' and 'social governance'. A key argument in these papers is that these forms of cross-boundary governance have arisen in response to the failure of the top-down government model to address the complex interactions and relationships among DBSS stakeholders.

Most (9 of 16) of the papers addressing collaborative governance highlight how relationships between multiple stakeholders are used to address complex public concerns and realize shared goals through consultation, resource and information sharing, and working together to develop and implement rules (Yang and Zhu, 2018; Yang and Zhu, 2019). Ma et al. (2018) refers to collaborative governance in China as 'three-party-governance' involving the public, private and civic sectors.

Several papers (7 of 16) discuss the responsibilities of government in the collaborative governance of DBSS. These responsibilities are described as fourfold: 'guidance', 'propaganda', 'institutional innovation' and 'regulation' (Jin and Bian, 2018). Through its role in 'propaganda', the government is understood to be responsible for enabling DBSS stakeholders to collaborate across their organizational boundaries to address problems and conflicts. The government is also understood to be responsible for the promotion of DBSS as a form of "green travel" and "active transport", and for publicising the right way to use the DBSS through the public media (Guo et al., 2017). The government's 'propaganda' role is linked to its responsibility for the 'regulation' and 'institutional innovation' of DBSS. The government is seen as having a responsibility to clarify the responsibilities of stakeholders and to establish collaborative frameworks, leadership structures and communication mechanisms governing the relationships between stakeholders (Gu and Zhang 2019). The government is understood as being responsible for the development of: ground rules and institutions (Jin and Bian, 2018), practical policies (Guo et al., 2017), collecting users' records of

misbehaviour in a national individual credit reporting system (Liu and Zhang, 2018), and ensuring that DBSS are effectively integrated into, and optimize the operation of, the transportation infrastructure (Guo et al., 2017). Whilst government is understood to play a significant role in the collaborative governance of DBSS, Jiang and Cai (2017) warn that excessive intervention may inhibit the vitality and development potential of DBSS.

Many of the papers (7 of 16) discuss the responsibilities of DBSS companies in collaborative governance. Their responsibilities are understood to include the optimization of the operating system, including technological innovations such as electric fences (Zhang et al., 2019), and the establishment of industry standards. A key focus of these responsibilities is to encourage the use of bicycles civilly and within the bounds of specific social responsibilities. To optimize operating systems, papers argue that companies need to set up a reporting and warning system for misbehaviour, develop suitable credit rating systems (Guo et al., 2017), and establish reward and punishment mechanisms for DBSS users (Lan et al., 2017). They also argue that they need to establish blacklists for users who misuse DBSS (Jin and Bian, 2018). For example, companies could add a function within mobile phone app-based systems to encourage DBSS users to report misbehaviour. These systems would reward informants with credit points and deduct credit points from violators (Han and Chen, 2019), and punish users who repeatedly violate the rules by freezing their accounts (Jin and Bian, 2018). Several papers discuss the responsibility of companies to establish data-sharing platforms to balance the supply and demand for bicycles and reduce the vacancy rate and enhance efficiency (Jin and Bian, 2018), and also help the government monitor and manage DBSS through data sharing (Peng and Wang, 2017).

Several papers (5 of 16) identify the responsibilities of DBSS users. Firstly, they argue that users have a responsibility to obey the rules, maintain ethical standards, and play a role in eliminating misbehaviour (Lan et al., 2017). For example, users are seen as being participants in the regulation process by reporting user misbehaviour through apps or phone calls. Secondly, users are encouraged to participate in volunteer programs to maintain the operation and management of DBSS, such as the "Mobike hunters" (Lan et al., 2017), who in their spare time help maintain the operation of DBSS and foster a good social atmosphere (Gu and Zhang, 2019). Finally, they argue that users should participate in decision-making by providing feedback when the government releases draft regulations (Jin and Bian, 2018).

A number of papers highlight the challenges which currently limit the effectiveness of cross-boundary collaborations in DBSS. These include:

- conflicts of interest and reduced levels of trust between stakeholders (Gao and Li, 2018);
- a lack of mechanisms to support communication between stakeholders (Liu and Zhang, 2018);
- the rigid departmentalization of responsibilities within government, and the imbalance of power between aspect of government (Xie, 2018).

Whilst collaborative governance is the most-discussed concept of governance within the papers, other governance concepts are also discussed (7 of 23). Weng (2018) argues that DBSS has been enabled through the rise of 'holistic governance' which aims to address the fragmentation of administrative structures by stressing the importance of collaboration between government departments. Xu et al. (2018) argue that the management of DBSS involves a dimension of 'social governance' in which the user's role extends beyond that of the 'rational economic man' to that of an idealized human who acts rationally to maximize personal utility or satisfaction. For example, Xu et al. (2018) point out that without any material rewards, many DBSS users in China's cities participate in volunteer programs in their spare time to maintain the orderly parking of bicycles. Volunteers within these

programs have been called “bicycle hunters”. Finally, Li and Han (2018) argue that DBSS has been enabled through ‘intelligent governance’, where big-data technology is being used as an effective tool to solve DBSS governance problems by providing a monitoring platform and information sharing system which promotes the accurate distribution and regulation of DBSS fleets (Hao and Wen, 2019).

4. Discussion

We hope that the findings will provide vital knowledge and increase awareness among DBSS researchers of trends and key themes in studies of DBSS governance. The following discussion summarizes these findings and compares them with broader BSS papers and literature reviews, and also identifies research gaps and possible directions for future study.

4.1. Geographic distribution

Almost all the academic peer-reviewed papers in the sample examine the governance of DBSS within Chinese cities, with few papers discussing DBSS outside China. This contrasts significantly with the academic peer-reviewed literature that has emerged around docked BSS, which has a much greater focus on cities outside of China, such as cities in Europe (Ricci, 2015), and cities in America and Australia (Fishman, 2016). One suggested reason for this is that China is the birthplace of DBSS, and its cities have become a dominant focus of research into DBSS.

4.2. Existing knowledge domains and evolutionary trends

The literature review identifies four key themes. Theme 1 is the economic model, property rights and externalities on which DBSS governance was founded. It first appeared in mid-2017. Discussion of the economic model underpinning DBSS focuses on whether DBSS is part of the sharing economy or only a form of ‘pseudo-sharing’. Discussion of property rights focuses on how DBSS has created a ‘quasi-public good’ based on the rights of bicycle users and ownership of bicycles by DBSS companies. In discussions of externalities, negative impacts include the oversupply of bicycles by competing companies, disorderly parking and the misbehaviour and ‘incivility’ of users. The positive impacts include addressing the gaps in urban transport networks and promoting the health of users. The discussion of positive externalities within the DBSS papers, particularly those surrounding health, reflect similar discussions within the literature on docked BSS. For example, a study by Fishman et al. (2013) discusses the benefits of public health and urban liveability posed by BSS, and also a study by Ricci (2015) explores how BSS help to reduce pollutant emissions and to improve air quality.

Theme 2, which also emerged in early 2017, is the problem of rebalancing the distribution of bicycles within DBSS to address demand. Whilst the problem of rebalancing is also addressed in the broader BSS literature, the majority of this literature is focused on the operator-based strategies, such as a study by Fishman (2016) and a study by Ricci (2015). A unique feature of the DBSS literature is the focus on both the operator-based and user-based strategies to balance the distribution of bicycles. One suggested reason for this is that rebalancing problems are more challenging in DBSS than in docked BSS because the fleets of DBSS bicycles in Chinese cities are much larger and more dispersed. Thus, DBSS needs more rebalancing. It is inefficient and costly to depend only on operator-based strategies. Moreover, the spatiotemporal distribution features of DBSS are also more flexible and complex than those of docked BSS. Therefore, DBSS needs dynamic redistribution at all times rather than just at night. In addition, several papers discuss the accuracy of modelling techniques used to predict DBSS demand, especially regression models. RF, LSTM NNs, and ANNs are the modelling techniques most recommended by researchers. Whilst modelling is also discussed in the broader BSS literature, a unique feature of the DBSS literature is the focus on dynamic and nonlinear modelling to predict

bicycle demand.

Theme 3 is regulation by government to eliminate the negative externalities of DBSS. This theme emerged within the selected literature in mid-2017 and reflects similar discussions in the broader BSS literature, such as a study by Ricci (2015) which explores the policy implications of BSS in European cities. Whilst similarities exist with the broader literature, a unique feature of the DBSS literature is its focus on challenges, including those that local governments face as a result of either their absence of government support or excessive interference. Specifically, the major issue for governments in regulating DBSS in Chinese cities is the vacancy for the government functions, the lack of policy and legal supports from higher authorities, and the confusion of government agencies’ responsibilities in early stage of DBSS. Such issues arise largely because of the failure of DBSS companies to communicate with local governments when they launch their services. Conversely, in cities in Australia, Europe and North America, DBSS companies tend to dialogue with local officials, sign memorandums of collaboration, or carry out pilot programs before they launch their services, and the major issue for government is local governments’ excessively strict sanctions and rules which make it difficult for DBSS to survive and develop. Inside and outside China, there is a lack of formal legal frameworks for DBSS.

Theme 4 was a shift within the DBSS literature from problem-finding and problem-defining to problem-solving. This theme did not emerge in the literature until mid-2017 and attention to it increased sharply in 2018. This shift was away from negative externalities and regulatory challenges towards a focus on the forms of governance being established to solve the challenges that DBSS poses. The forms of governance discussed in papers include social governance, holistic governance and intelligent governance, but collaborative governance is the key focus. Emerging forms of collaborative governance in China are discussed as strategies to ensure the long-term sustainability of DBSS by maintaining the orderly parking and civilized use of bicycles (Yao et al., 2019). Whilst the broader BSS literature emphasizes the significance of multi-sector engagement (Fishman, 2016), the strong focus of the DBSS literature on collaborative governance is unique.

4.3. Policy recommendations for DBSS

Based on our analysis of the governance issues discussed in the 95 papers, we recommend several areas which DBSS policy should consider more closely, for cities both inside and outside China. In regard to legislation, whilst the many local governments (China and outside China) have issued regulations since August 2017, many problems in DBSS management are not covered within the provisions of these regulations, such as the industry access rules and withdrawal rules, protection of user deposits, and data sharing. We thus recommend filling the gap of the extant legal frameworks around DBSS and introducing new legal provisions for specific DBSS issues. These may include aforementioned issues and detailed management policies, such as restrictions on the number of bicycles released by companies, measures to regulate poorly run companies, bicycle parking standards, and data sharing standards. Moreover, it is not enough to publish these regulations. What is more important is how to implement these management policies and regulations. Notably, for China, suggestions are that high authorities should empower local government agencies, increase the legal power of local regulatory frameworks, and promote consistency in the implementation of regulations throughout the country by developing metrics for local governments to monitor compliance. In regard to governance, we suggest that governments at all levels should establish holistic administration structures and clarify the regulatory responsibilities of local government departments to overcome their “functional fragmentation”. Local governments should be encouraged to facilitate collaborations with stakeholders including other levels of government, DBSS companies, users, academia, general public, NGOs for mutual benefits. Such public-private-society collaborations are already carried out in some large Chinese cities. For example, in Guangzhou city, DBSS

companies collaborated with sub-district offices and resident communities (property-management offices) in delineating legal parking space for DBSS. Such “street offices–resident’s communities–DBSS companies” collaborations can effectively solve parking issues (Wang et al., 2020).

4.4. Research gaps and future directions

An evident strength of the literature on DBSS governance is its coverage of the problems that have resulted from the emergence of DBSS, and the forms of cross-boundary governance that have evolved to address them. However, there are several research gaps and opportunities for future research.

There are currently only a few studies on DBSS in cities outside of China. Since 2017, DBSS have been launched in cities across the world (Gu et al., 2019a). More studies which focus on these cities should be encouraged. These studies could be used to compare and understand how the property rights, economic models, externalities, regulatory systems and governance frameworks that have evolved in China differ from those that have evolved in other political, social and cultural contexts. Secondly, most of the papers in this review are from three disciplines: public management, transport and business, with limited research from other disciplines such as law, political economy, urban planning, and information technology. A more comprehensive understanding of DBSS governance from a greater diversity of disciplines may help expand our understanding of DBSS.

In terms of the depth of research, firstly, the papers dealing with Theme 1 explain the major debates around the attributes of DBSS and its externalities. From the perspective of traditional economics, some researchers see DBSS as a quasi-public good, but others argue DBSS can’t be fully defined as a quasi-public good because exclusivity and competitiveness in DBSS are constantly changing in response to changing spatiotemporal conditions. There is still a lack of a consensus on the categorization of DBSS in academia, and this topic needs further discussion and analysis. Secondly, the papers examining Theme 2 focus largely on traditional operator-based and static strategies and pay little attention to the user-based strategies and dynamic approaches that are being used in DBSS rebalancing. More attention could be paid to the current and potential roles of user-based and dynamic approaches, and the challenges and opportunities these approaches bring to DBSS. Thirdly, whilst the papers dealing with Theme 3 analyse government-led regulation of DBSS, most of them do not examine the regulation frameworks in any depth. For example, they do not systematically search for and interpret DBSS-relevant regulations and legal documents from around the world. Only a few papers discussed regulations issued by China’s local governments, and these papers only focused on the regulation of DBSS within large Chinese cities. Further in-depth studies are needed of the regulatory frameworks being applied in small and medium-sized cities, along with cities outside China, to develop a more comprehensive understanding of the types of regulations being used to govern DBSS. Finally, the depth of research into DBSS could be improved by expanding on the literature examining Theme 4. Whilst papers dealing with Theme 4 discuss the components that make up collaborative governance of DBSS, only a few of them empirically examine these components through detailed research in specific DBSS contexts. Most of the papers only explain the applicability of

collaborative governance models at a partial or conceptual level. For example, Ma et al. (2018) only partly use the variables of the Integrative Analytical Framework (IAF) of Emerson et al. (2012) to discuss the governance of Shanghai’s DBSS, and Gao and Li (2018) partly use the Collaborative Governance Model (Ansell and Gash, 2008) to discuss the governance of China’s DBSS. They do not explore a significant number of the variables examined in these existing analytical frameworks and models, and as a result, they provide only partial insights into how these frameworks might be used to understand DBSS governance. Moreover, most papers, especially Chinese papers, stay at the theoretical level and lack empirical analysis of governance issues. Systematic, empirical investigations are needed that more fully apply collaborative governance frameworks to DBSS in order to understand how the governance models within DBSS emerge and are maintained. Future research needs to address such question as: How are collaborative governance frameworks for DBSS initiated in cities? and, how do the multiple stakeholders involved in DBSS participate in and network with each other?

5. Conclusion and limitations

This is the first systematic review of the burgeoning peer-reviewed literature on the governance of DBSS. It is unique in that its scope extends beyond English literature to include Chinese peer-reviewed literature, providing the reader with a broader understanding of a phenomenon that first appeared in Chinese cities in 2016 and rapidly spread to other cities around the world. The review uses thematic coding of the selected papers, supported by bibliometric analysis and knowledge mapping through the VOSviewer software, to identify four key themes within the literature on the governance of DBSS: 1) the inherent characteristics of the sharing economy and the externalities underpinning the governance of DBSS, 2) the rebalancing strategies for DBSS, 3) government regulation of DBSS and 4) cross-boundary collaboration in the governance of DBSS. The review provides insight into the evolution of these themes since 2016, and it reveals that the literature has a strong focus on the governance of DBSS in Chinese cities.

Whilst the review will help scholars, company managers, and government policymakers to understand trends in the rapidly emerging field of DBSS research and practice, it is not without its limitations. First, the data used in this review was collected from three data bases: WoS, Scopus and the CNKI. Whilst these are authoritative sources, some important and valuable literature may have been overlooked. Secondly, this review only focuses on peer-reviewed journal papers, and excludes grey literature, conference proceedings, and book chapters. Future reviews could examine other databases and types of documents to present a more comprehensive understanding of DBSS.

Declaration of competing interest

The authors declare no conflicts of interest.

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Appendix 1

Thematic coding of 95 selected papers

No	Year published and authors	Key topics examined in paper	Themes addressed in each paper				Disciplinary focus of paper
			Theme 1: The inherent characteristics of the sharing economy and its	Theme 2: Rebalancing	Theme 3: The government	Theme 4: The cross-boundary	

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No	Year published and authors	Key topics examined in paper	Themes addressed in each paper				Disciplinary focus of paper
			Theme 1: The inherent characteristics of the sharing economy and its externalities underpinning the governance of DBSS	Theme 2: Rebalancing problem of DBSS	Theme 3: The government regulation of DBSS	Theme 4: The cross-boundary collaboration in the governance of DBSS	
			externalities underpinning the governance of DBSS	problem of DBSS	regulation of DBSS	collaboration in the governance of DBSS	
1	Lan et al. (2017)	Enabling factors of value co-creation in DBSS	✓			✓	Business economics; public management science; environmental science Transport research
2	Pal and Zhang (2017)	Static rebalancing problems of DBSS		✓			Public management science
3	Zhu and She (2017)	Discussion on the definition of “sharing economy”	✓				Business economics; public management science Business economics
4	Jiang and Cai (2017)	Role that government plays in the regulation of DBSS	✓		✓		Science of law
5	Zhang et al. (2019)	Economic characteristics and existing problems of the DBSS	✓				Business economics
6	D. Z. Wang and He (2017)	Legal regulation for misbehaviours in the DBSS			✓		Science of law
7	Q. Wang and He (2017)	Challenges that sharing economy faces in the development of DBSS and the solutions	✓		✓		Business economics
8	Deng and Li (2017)	Characteristics of cash pledge in DBSS and its regulatory rule			✓		Public management science
9	Song (2017)	Logic of consultation governance in DBSS			✓	✓	Political science; public management science Business economics
10	Wang and He (2017)	Existing problems of DBSS and the solutions from the perspective of “public goods” theory	✓				Science of law
11	Song (2017)	System of legal regulation operating in DBSS			✓		Science of law
12	Peng and Wang (2017)	Government and governance in DBSS and solutions			✓		Public management science
13	Tan (2017)	The “race to the bottom” in DBSS and solutions	✓				Science of law
14	Guo et al. (2017)	Mechanisms of collaborative governance in DBSS	✓		✓	✓	Public management science
15	Qin and Wang (2017)	Collaborative mechanism in the governance of DBSS	✓		✓		Business economics; public management science
16	Xu (2018)	Shared participation and social publicity in governance of DBSS	✓				• Sociology; public administration
17	Caggiani et al. (2018)	Dynamic rebalancing framework in DBSS		✓			Transport research
18	Liu et al. (2018)	Static rebalancing framework in DBSS		✓			Transport research
19	Lu et al. (2018)	How DBSS changes user travel behaviours and minimize the environmental and social impacts of an integrated transport system	✓				Energy fuels
20	Sun (2018)	The development and governance of DBSS				✓	Public management science
21	Xu et al. (2018)	Bicycle demand forecasting		✓			Transport research
22	Nie and Zhang (2018)	Cost optimization and management strategy of DBSS		✓			Business economics
23	Hao et al. (2018)	Selection of parking station of DBSS based on minimum vertex cover problem		✓			Transport research
24	Fan (2018)	Local legislation in the field of DBSS through case study of 9 Chinese cities			✓		Science of law
25	Chen and Wang (2018)				✓		Science of law

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No	Year published and authors	Key topics examined in paper	Themes addressed in each paper				Disciplinary focus of paper
			Theme 1: The inherent characteristics of the sharing economy and its externalities underpinning the governance of DBSS	Theme 2: Rebalancing problem of DBSS	Theme 3: The government regulation of DBSS	Theme 4: The cross-boundary collaboration in the governance of DBSS	
26	Jin and Bian (2018)	Legislative model of local legislation in the regulation of DBSS Collaborative governance of DBSS through case study of the perspective of stakeholders				✓	Business economics; science of law; public management science
27	Xu et al. (2018)	Participation of users and volunteers in the governance process of DBSS				✓	Sociology
28	Yang and Zhu (2018)	Factors that influence parking behaviours in DBSS				✓	Public management science
29	Li et al. (2018)	Vandalism in DBSS and solutions			✓		Business economics; public management science
30	Xie (2018)	Reasons of unsuccessful collaboration in the collaborative governance of DBSS				✓	Public management science
31	Gao and Li (2018)	Collaborative governance of DBSS through SFIC model				✓	Public management science
32	Peng (2018)	Imitation behaviour in DBSS and collaborative governance of DBSS				✓	Public management science
33	Liu and Zhang (2018)	Negative externalities of DBSS and regulatory approaches	✓		✓	✓	Public management science
34	Zheng and Li (2018)	Negative externalities of DBSS, and the government responsibilities and innovation in DBSS	✓		✓		Political science; public management science
35	Sun and Yuan (2018)	Government regulation of DBSS and DBSS as part of the sharing economy			✓		Science of law
36	X. L.Weng (2018)	Social and moral governance in DBSS				✓	Ideology and politics
37	Weng (2018)	Holistic governance in DBSS			✓	✓	Public management science
38	Hao (2018)	Governance innovation in the sharing economy	✓				Business economics
39	Zheng and Chen (2018)	Innovation and optimization of governance in DBSS through the collaborative network perspective	✓			✓	Public management science
40	Li and Han (2018)	Evolution of governance in DBSS and big data governance in DBSS			✓	✓	Public management science
41	Gan and Lou (2018)	Characteristics of DBSS, collaboration between government and private sectors in the development and governance of DBSS	✓				Public management science
42	Leng and Guo (2018)	Government responsibilities in the governance of DBSS	✓		✓		Public management science
43	Cheng and Qi (2018)	Government regulation in DBSS through local policy documents of 15 Chinese cities			✓		Public management science
44	Ma et al. (2018)	Challenges of collaborative governance in DBSS				✓	Public management science; environmental science
45	Shi et al. (2018)	Stakeholder networks in governance of DBSS	✓			✓	Environmental science; public management science
46	Jia et al. (2018)	Factors that affect the use of civilization in DBSS from the perspective of stakeholders				✓	Public management science; environmental science; business economics

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No	Year published and authors	Key topics examined in paper	Themes addressed in each paper				Disciplinary focus of paper
			Theme 1: The inherent characteristics of the sharing economy and its externalities underpinning the governance of DBSS	Theme 2: Rebalancing problem of DBSS	Theme 3: The government regulation of DBSS	Theme 4: The cross-boundary collaboration in the governance of DBSS	
47	Du and Cheng (2018)	Characteristics and influential factors of travel patterns in DBSS	✓				Transport research
48	Gao et al. (2018)	Spatiotemporal distribution forecasting of DBSS and rebalancing strategy		✓			Transport research
49	Qiu and He (2018)	DBSS and its externalities	✓				Green sustainable science technology; environmental science
50	Chen et al. (2018)	DBSS's attributes	✓				Business economics
51	Yao et al. (2019)	User behaviour, externalities and credit supervision mechanism of DBSS	✓				Public management science; environmental science; business economics
52	Ai et al. (2019)	Short-term spatiotemporal distribution forecasting of DBSS		✓			Transport research
53	Ban and Hyun (2019)	User participation-based rebalancing approach of DBSS		✓			Transport research
54	Du et al. (2019)	The spatiotemporal usage patterns of DBSS		✓			Transport research
55	Gu et al. (2019b)	Optimization algorithm of usage efficiency of DBSS		✓			Transport research
56	Lahoorpoor et al. (2019)	Static rebalancing problem of DBSS		✓			Transport research
57	Zhai et al. (2019)	Forecasting of fleet size and rebalancing of DBSS		✓			Transport research
58	Tian et al. (2019)	Users' demand fluctuation in DBSS		✓			Transport research
59	(Wu et al., 2019)	User participation-based rebalancing approach of DBSS		✓			Transport research
60	Zhang and Meng (2019)	Rebalancing strategy of DBSS		✓			Transport research
61	Yu et al. (2019)	Model and algorithm of DBSS rebalance		✓			Transport research
62	Zhang et al. (2019)	Electric fence planning of DBSS		✓			Transport research
63	Zhao et al. (2019)	Influence of built environment for DBSS rebalance		✓			Transport research
64	He et al. (2019)	Static and dynamic rebalancing strategy of DBSS		✓			Transport research
65	Guan and Lu (2019)	User participation-based rebalancing approach of DBSS		✓			Transport research
66	Liu and Pan (2019)	Genetic algorithm for solving DBSS rebalancing problem		✓			Transport research
67	Xu et al. (2019)	Rebalancing strategy for broken shared bicycles		✓			Transport research
68	Jiang et al. (2019)	Factors influencing disorderly parking issues in DBSS	✓				Urban design
69	Wang et al. (2019)	Discrete differential evolution algorithm for DBSS rebalancing problem		✓			Transport research
70	Wang et al. (2019)	Development and challenges of DBSS in China	✓		✓		Environmental science; green sustainable science technology
71	Hao and Wen (2019)	Intelligent governance in DBSS				✓	Public management science
72	Fang and Yang (2019)	Legal regulation of DBSS through the multiple stream's framework	✓		✓		Public management science

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No	Year published and authors	Key topics examined in paper	Themes addressed in each paper				Disciplinary focus of paper
			Theme 1: The inherent characteristics of the sharing economy and its externalities underpinning the governance of DBSS	Theme 2: Rebalancing problem of DBSS	Theme 3: The government regulation of DBSS	Theme 4: The cross-boundary collaboration in the governance of DBSS	
73	Pan et al. (2019)	Capacity range length insertion heuristic algorithm for DBSS rebalancing problem		✓			Transport research
74	Yue and Hu (2019)	Collaborative governance of DBSS through the perspective of multiple theories	✓		✓	✓	Public management science
75	Xie et al. (2019)	Dynamic rebalancing strategy of DBSS		✓			Transport research
76	Yang et al. (2019)	Public participation and feedback in the process of decision-making in the governance of DBSS			✓		Public management science
77	Gu and Zhang (2019)	Governance of DBSS through the perspective of co-production				✓	Public management science
78	Gu et al. (2019)	Development and challenges of DBSS	✓		✓		Business economics; transport research
79	Ma et al. (2019)	Value co-creation in DBSS	✓			✓	Environmental science; green sustainable science technology
80	Han and Chen (2019)	The dilemma of regulation in DBSS and collaborative governance through the CSG framework	✓			✓	Public management science
81	Zhang and Hua (2019)	Regulation of DBSS	✓				Public management science
82	Yang and Zhu (2019)	Collaborative governance of DBSS with a focus on urban public space				✓	Public management science
83	Yin et al. (2019)	Value co-creation and value co-destruction of DBSS				✓	Environmental science; transport research
84	Yan and Liu (2019)	Dynamic rebalancing strategy of DBSS		✓			Transport research
85	Jie et al. (2020) – available online 06 November 2019	Data-driven approach for DBSS rebalancing		✓			Transport research
86	Liu et al. (2019)	Responsible Innovation in the DBSS	✓		✓	✓	Public management science; business economics
87	Cheng et al. (2019)	Collaborative geofence sites				✓	Computer science and information system; engineering electrical electronic; telecommunications
88	(Wang and Ahsan, 2019)	Risk and risk management strategies in DBSS management			✓	✓	Public management science; business economics
89	Chen (2019)	The obligations of the DBSS companies			✓	✓	Law
90	Hauf and Douma (2019)	The government governance of DBSS			✓		Engineering civil; transport research
91	Hirsch et al. (2019)	The development and government governance of DBSS in North America			✓	✓	Transport research
92	An (2019)	Collaborative governance in the DBSS				✓	Art
93	Sun (2019)	Credit-based supervision policies in DBSS			✓	✓	Public management science; business economics
94	Zhao et al. (2019)	Collaborative governance on disorderly parking			✓	✓	Public management science; business economics
95	Wang et al. (2019)	Public-private partnerships in DBSS			✓	✓	Public management science

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Note: Papers marked with an * are part of the literature review sample.

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