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Article

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Research Article

To promote experience sharing in urban transitions: An integrated framework of experience mining and triangulation

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ABSTRACT

Many cities have put relentless efforts in promoting transformational changes to tackle urban challenges, accumulating considerable experiences and knowledge for other cities to learn. To reuse the successful experiences in an effective way, previous studies have developed experience mining systems, which adopt Case Base Reasoning as smart decision support systems to provide valuable references on how to manage and solve the current problems. However, the experience mining systems generally pay limited attention to the feasibility and applicability of transition experiences for the target city, making it challenging to validate results considering the complexity of urban transitions. To fill the gap, this paper proposes a methodological framework to evaluate matching degrees of past experiences by integrating experience mining with triangulation, aiming at selecting the most appropriate case for the target city from multiple perspectives. A case study of Beijing is further conducted, with different methodologies leading to distinguished results, which proves the necessity of employing various methods to enhance the validity of experience mining for urban transitions. It is envisaged that the integrated framework could help future practitioners and researchers to make better-informed choices with experience mining systems during experience learning or theory development in urban transitions.

1. Introduction

Rapid urbanization has caused massive sustainability challenges worldwide, necessitating transitions in current governance to promote a more sustainable urban growth (Affolderbach & Schulz, 2016). There have been considerable initiatives implemented by either international organizations or local governments, including Local Governments for Sustainability (ICLEI), C40 Cities, WWF One Planet Cities and 100 Cities Initiatives, which accumulated large amount of experience for worldwide cities on how to achieve the sustainable transition. Previous studies have revealed that lessons from forerunners can serve as valuable references for other cities with similar contexts (Akter et al., 2021; Ochoa et al., 2018). By assisting policymakers in foreseeing potential problems and formulating effective action plans, experience learning is perceived as a significant process in facilitating urban transitions (Wang et al., 2019).

To effectively learn experiences from past practices, an experience mining system (ExMS) is developed for sharing experiences in promoting sustainable urban transitions (Shen et al., 2013; Wu et al., 2020). By integrating the principles of knowledge sharing with

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data mining techniques, ExMS is designated to extract previous sustainable urbanization practices and refine them into practical experiences for new scenarios. It was originally built based on Case Base Reasoning (CBR), which is widely used in many fields such as problem diagnosis (López et al., 2011), business management (Shen et al., 2017), smart city system design (Jnr, 2021; Orłowski et al., 2016), etc. Similar to the CBR approach, ExMS involves four components: retrieving most similar cases, reusing cases to solve current problems, revising the retrieved solution if necessary, and retaining the new adopted solution as a new case (Shen et al., 2013; Yeh & Shi, 1999). The case retrieval process plays the most significant role in implementing ExMS as it directly influences the effectiveness of applying mined cases as references to solve the given problems (Pereira & Madureira, 2013; Shen et al., 2017). Existing ExMS studies generally consider problem nature and the similarity of urban backgrounds for the case retrieval process, assuming that experiences from different cities would lead to the same level of effectiveness and applicability if they have similar problems and urban features (Shen et al., 2013; Wu et al., 2020).

However, as indicated by previous research, additional significant factors influence the outcomes of experience transfer for urban transitions. One is the transition performance of past practices, including objective outcomes that can be evaluated with indicators and the subjective well-being of people influenced by transitions. Previous studies have proved the significance of assessing transition outcomes, as it can ensure that knowledge learning is based on successful sustainable initiatives and avoid ineffective experience sharing (Forrest & Wiek, 2014; Legrand, 2012; Sanderson, 2002). Another is the policy context. Many case studies have focused on previous experience transfer in urban sustainability, showing that differences in political contexts would draw limits to the degree of experience learning, which may sustain inertia and resistance to change and counteract the successful implementation of previous practices (Nagorny-Koring & Nochta, 2018). Therefore, experience transfer should be based on careful studies of urban settings (McCann, 2011; Sheldrick et al., 2016; Shefer, 2019).

While transition performance and policy contexts play essential roles in successful experience transfer, they are not considered during the case retrieval process of existing ExMS. Cities may learn from experiences with the most similar urban features and problem nature but not necessarily the most feasible and applicable, which could affect the ultimate effectiveness of experience learning as indicated by the previous studies (Forrest & Wiek, 2014; Sheldrick et al., 2016). As ExMS is designated to provide optimal solutions for the given scenarios to learn, the absence of these two factors in the matching mechanism could lead to suboptimal results and undermine the approach's validity and credibility. To address the problem, this study introduces triangulation into the case retrieval process of ExMS. Triangulation refers to a research strategy that integrates multiple methods, data sources, theories, or investigators to capture social reality in a comprehensive manner (Denzin, 2017). Although triangulation has been seldomly applied in urban transition studies, it has been widely perceived in other social science fields as an effective way to enhance methodological validity and credibility (Farquhar et al., 2020).

There are two objectives in this study: first, to modify the case retrieval process of existing ExMS by triangulating different evaluative methodologies; and second, to conduct the new case retrieval process in a case study and demonstrate how it can improve the validity and credibility of experience mining while remaining practicable for policymakers to utilize.

To achieve the research objectives, the rest of the paper is organized as follows: existing research of ExMS and triangulation is reviewed in Section 2. Section 3 illustrates the integrated assessment framework for modifying the matching process in ExMS. Section 4 presents a demonstration of applying the integrated assessment framework, and Section 5 further compares the validity and credibility of ExMS with and without triangulation. Section 6 provides the conclusions of the study.

2. Literature review

ExMS is proposed by Shen et al. (2013) to extract previous urbanization practice experiences as decision-making references to address new problems. It consists of an extracting process, a refinery process, and a mine-sweeper. The extracting process identifies and collects urban transition practices from various sources and registers them in a pre-defined architecture before storing them into a case database. The refinery process enables the database to index all the cases and recall them via index values, while the mine-sweeper describes the new problem within the architecture of ExMS, matches it with previous practices, and selects the plausible cases to solve the target problem.

On this basis, ExMS is further applied in various areas concerning urban sustainability. For instance, Wang et al. (2019) used this approach to mine lessons from previous practices, sending alarming messages to decision-makers to avoid the recurrence of potential problems and take proper measures for urban sustainability. Both Huang et al. (2019) and Wu et al. (2020) introduced an experience mining system to assist policymakers in reusing past practices as references when tailoring low carbon city strategies. Zhou et al. (2021) adopt the experience mining method to extract experiences from previous urban renewal projects for supporting policymakers to choose a suitable urban renewal mode considering multiple stakeholders.

As the initial ExMS only considers the similarity of problem nature between the target case and mined cases, Shen et al. (2017) further pointed out the significance of incorporating the similarity of urban backgrounds in the case retrieval process, as the background diversifications may lead to different outcomes even though the exact solution is applied to similar problems. Shen et al. (2017) proposed a method to measure the similarity of urban features between the target case and mined cases, including landform, climate, urban scale, development level, Gini coefficient, and GDP performance. In line with this, several studies also calculate the degree of similarity for urban characteristics to find the best match in their ExMS (Huang et al., 2019; Wang et al., 2019; Wu et al., 2020).

Although similarity measurement of urban characteristics provides a complementary dimension for the matching mechanism, it still lacks consideration of the mined cases' transition performance and policy contexts. As these factors play significant roles in successful experience transfer in urban transitions, their ignorance of them would lead to doubts about the validity and credibility of ExMS. Therefore, the matching mechanism needs to be further modified by evaluating the matching degree of mined cases with the target case, taking urban features, transition performance and policy contexts into consideration.

According to existing research, triangulation can serve as a means of corroborating or completing results to increase the validity and credibility of evaluation studies (Ammenwerth et al., 2003; Kern, 2018). Originated from geometric techniques, the theory of triangulation refers to employing different methodologies, theories, or data sources to investigate the same phenomenon (Denzin, 1978). It can either validate the results when different triangulated parts generate congruent results or enhance the comprehensiveness of results when one part of the study provides complementary information to other parts (Campbell et al., 2020; Malek & Desai, 2020). Based on the idea of triangulation, many evaluative urban studies have incorporated multiple methods in their research design to study the same phenomenon, counterbalancing the weaknesses of one method with the strengths of another to address the lack of confidence in the research and increase the validity of results. For instance, Erfani (2020) conducts a methodology triangulation to evaluate the process and results of participatory urban redevelopment in a low-income residential area. Wang et al. (2019) compare two studies for triangulation to detect the interests and influences of different stakeholders in Electric Road Systems development, which aims at overcoming a traditional deficiency of interview-based methods. However, triangulation is still underused in empirical studies, which is unfavorable for gaining a better picture of the phenomenon (Malek & Desai, 2020).

Based on the above discussion, the study extends the existing ExMS by introducing triangulation into the case retrieval process to examine which experiences are suitable for the target case more comprehensively.

3. An integrated framework of ExMS and triangulation

This study incorporates a methodology triangulation into the case retrieval process of ExMS to consider the three significant influencing factors for successful experience transfer in urban transitions, namely urban features, transition performance and policy contexts. In this integrated framework, these factors are examined by different methodologies, which evaluate the degree of similarity, feasibility and applicability between the target case and the mined cases, respectively. A weighted overall degree of matching is further calculated to select the most suitable cases for solving problems. The methodological framework consists of four steps, as shown in Fig. 1.

3.1. Degree of similarity in urban features

This study continues to use the hybrid similarity measurement method proposed by Shen et al. (2017) to evaluate the degree of similarity in urban features. The similarity is measured from six representative urban characteristics from multiple perspectives. Landform and climate represent the environmental similarity, population and urbanization level represent social similarity, Gini coefficient and GDP per capita represent economic similarity. After ExMS generates a list of plausible cases, their similarity in different urban characteristics with the target case is calculated respectively. According to Shen et al. (2017), when the urban characteristics of the target city and reference cities are described in crisp symbols, the similarity is measured using Eq. (1).

$$S_k(Z_0, Z_i) = \begin{cases} 1, & \text{if } U_{0k} = U_{ik} \\ 0, & \text{if } U_{0k} \neq U_{ik} \end{cases} \tag{1}$$

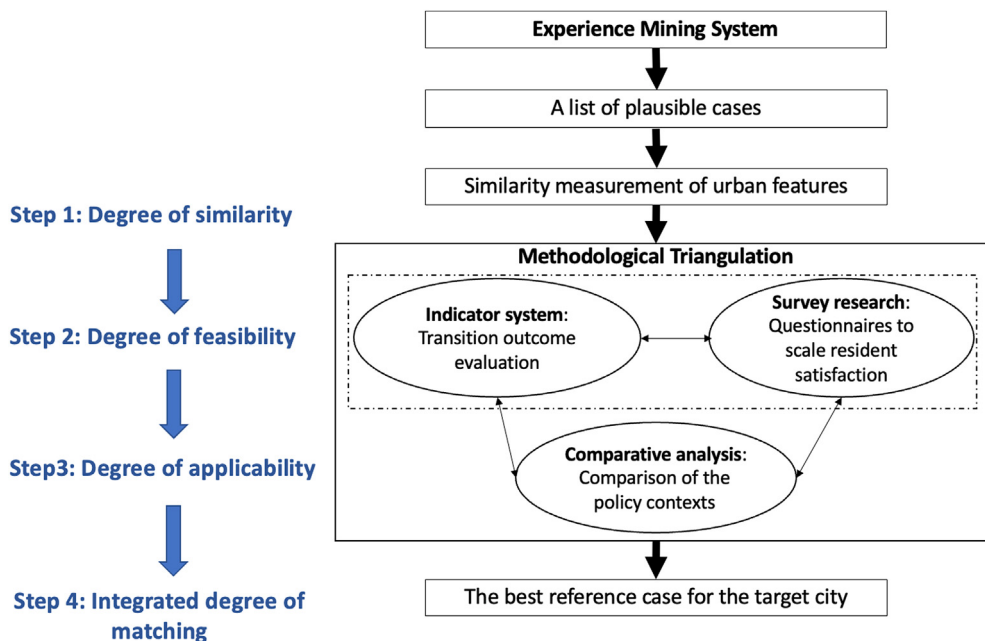


Fig. 1. The methodology framework.

where U_{0k} represents k th urban background of the target city and U_{ik} represents k th urban background of the i th mined case. If the urban characteristics are described in crisp numbers, the similarity is calculated using a distance-based method, as shown in Eq. (2).

$$S_k(Z_0, Z_i) = 1 - \frac{|U_{ik} - U_{0k}|}{\beta - \alpha} U_{ik}, U_{0k} \in [\alpha, \beta], i \in M, k \in N \tag{2}$$

$$\alpha = \begin{cases} \text{Min}_i^M U_{ik}, & \text{when } U_{0k} > \text{Min}_i^M U_{ik} \\ U_{0k}, & \text{when } U_{0k} < \text{Min}_i^M U_{ik} \end{cases}$$

$$\beta = \begin{cases} \text{Max}_i^M U_{ik}, & \text{when } U_{0k} < \text{Max}_i^M U_{ik} \\ U_{0k}, & \text{when } U_{0k} > \text{Max}_i^M U_{ik} \end{cases}$$

An integrated measurement is further conducted to indicate the overall similarity level of urban characteristics between the mined cases and the target case, using Eq. (3).

$$S(Z_0, Z_i) = \sum_{j=1}^6 w_k S_k(Z_0, Z_i) \tag{3}$$

where w_k is the weighting value based on the significance of the feature k . Z_0 represents the target case, and Z_i represents the i th mined cases. $S_k(Z_0, Z_i)$ denotes the similarity value between Z_0 and Z_i of the specific urban feature k . To generate an overall degree of matching at the end, the heterogeneous scores generated by different methodologies should be transferred into a common domain before combining them (Jain et al., 2005). Hence, the integrated similarity level generated by Eq. (3) is normalized to calculate the degree of feasibility, using Max Abs Scaling method as shown in Eq. (4). This method can scale the values to [-1,1] and displays the difference from the maximum value.

$$N'_i = \frac{N_i}{\max N_i} \tag{4}$$

where N'_i is the normalized scores of the i th city, and N_i represents the original scores of the i th city, while $\max N_i$ denotes the maximum value of all the cities.

3.2. Degree of feasibility

Indicator systems and survey research are chosen as methodologies to evaluate the impact of transition on the urban system and residential well-being, respectively, which indicate the degree of the feasibility of the mined cases. Indicator systems are commonly used in performance assessment. They can visualize the differences between ex-ante and ex-post situations to examine whether the action plans reach their target and solve the problems (Shen et al., 2011). In urban studies, a wide variety of transition indicator systems are developed not only at the city level (Ali-Toudert et al., 2019) but also in specific sectors, such as energy (Marquez-Ballesteros et al., 2019), waste management (Deus et al., 2020), and mobility (Reisi et al., 2020). As for survey research, it is widely applied in social and psychological research to describe and explore human behavior by collecting information from a sample of individuals via their responses to the questions (Booth et al., 2018; Krosnick, 1999). Many studies have conducted questionnaire surveys to investigate the residential satisfaction of social groups experiencing urban redevelopment or other transformation (Sheng et al., 2021; Temelová & Dvořáková, 2012). It is proved that survey research is applicable in investigating how dramatic changes affect the everyday lives of urban residents and therefore evaluating residential satisfaction concerning transitions. The performance scores generated by both indicator systems and survey research are normalized following Eq. (4).

3.3. Degree of applicability

The similarities of policy contexts are measured between the target case and mined cases to indicate the degree of applicability of past practices, as learning from experiences with similar policy backgrounds can minimize possible contextualization barriers (Peng et al., 2019). Comparative analysis is conducted to examine whether the target case has the exact enabling mechanisms as the previous experiences, which is widely used to analyze the gap between transition governance in different cities (Hodson et al., 2013; Hordijk et al., 2014). As the policy contexts are in the format of linguistic terms, instead of crisp numbers, they cannot be calculated using a distance-based similarity measure. Hence, the similarity between the target case and mined cases are measured by judging whether the components of policy contexts are equivalent, which are generally applied to crisp and fuzzy symbols, as shown in Eq. (5) (El-Fakdi et al., 2014; Shen et al., 2017).

$$S_i(Z_0, Z_i) = \begin{cases} 1, & \text{if } P_{0i} = P_{ii} \\ 0, & \text{if } P_{0i} \neq P_{ii} \end{cases} \tag{5}$$

where P_{0t} represents t th contextual factor of the target city and P_{it} represents t th contextual factors of the i th mined case. An integrated similarity is measured considering all the contextual factors in the comparative analysis, as shown in Eq. (6).

$$S(Z_0, Z_i) = \sum_{t=1} w_t S_t(Z_0, Z_i) \quad (6)$$

where w_t is the weighting value based on the significance of the t th contextual factor. The integrated similarity of policy contexts is further normalized using Eq. (4) to calculate the degree of applicability.

3.4. Integrated degree of matching

By integrating the degree of similarity, feasibility and applicability, the overall degree of matching between the target case and a mined case is measured as Eq. (7).

$$M_i = \sum_{j=1}^4 w_j N_{ij} \quad (7)$$

where M_i is the integrated degree of matching of the i th city and w_j is the weighting value for indicating the significance of the j th methodology in case retrieval process. N_{ij} denotes the normalized degrees of i th city using j th methodology. The higher the value of M_i , the more suitable of using the reference city for solving problems in the target city. The convergence or divergence of the triangulation results can be seen by comparing the integrated degree of matching with the similarity degree of urban features as calculated by Eq. (3).

4. A demonstration of applying the integrated framework

To demonstrate the proposed integrated framework of ExMS and triangulation in Fig. 1, this study selects the sustainability transition of the transport system in Beijing as a target problem for mining similar cases. As China's major political, financial and commercial center, Beijing has a high mobility demand every day. Its layout comprises multiple outer ring roads with inter-ring road route connections, characterized by the rapid growth of population, economics and motorization over decades (Xu et al., 2017). The traffic pressures have led to a series of problem, including air pollution and greenhouse gas emissions (Zhao & Hu, 2019). Therefore, Beijing is a symbolic city that needs urgent action to transition into a sustainable mobility system. The mined experience of Beijing can be shared and promoted in many other Chinese cities that face the same challenges.

This demonstration is used to show the process of finding the best match among the reference cases mined by the original ExMS, which were selected based on the nature of the problem. Since ExMS is still at the conceptual stage and the integration framework modifies the case retrieval process rather than the whole system, the previous process is by default completed, including the extracting process, the refinery process, and the problem description and matching of the mine-sweeper. The demonstration focuses on the case selection phase, applying the integrated framework to help identify the best match for Beijing to learn from. It is considered that the best match can offer useful reference for solving the problems faced in Beijing.

To collect existing transition experiences towards sustainable transport, the study searches for existing urban transition practices first from the following sources: (a) existing sustainable cities alliances, such as C40 Cities Climate Leadership Group, New York City Global Partners, and Local Governments for Sustainability (ICLEI); (b) relevant literature; (c) city's official development plans or reports. As a result, six high-density metropolises with transition practices for sustainable mobility are collected to represent the plausible cases mined from the database of ExMS for case selection by applying the integrated framework.

- Singapore: control car ownership to reduce car dependency while promoting public and shared mobility (Toh and Phang, 1997; Diao, 2019)
- Seoul: use Information and Communications Technology to support multi-modalism (Lee et al., 2015)
- Hong Kong: improve the quality of public transport through competition (Tang & Lo, 2008)
- London: introduce a congestion charging scheme to relieve traffic pressure (Pike, 2010)
- Paris: dismantle urban expressways and develop right-of-way bus lanes (Halpern & Le Galès, 2016)
- New York: corridor-based transportation management (New York State Department of Transportation, 2006)

Table 1

Urban features of six reference cities and the target city.

City	Landform (S1)	Climate (S2)	Population (S3)	Urbanization(%) (S4)	Gini index (%) (S5)	GDP per capita (\$) (S6)
Beijing	Plain	Semi-humid continental	18777000	87.00	46.20	17064
Singapore	Plain	Tropical	5629000	98.00	39.00	55646
Seoul	Plain	Humid continental	9860000	81.63	29.50	28732
Hong Kong	Mountains	Oceanic subtropical	7291000	100.00	53.90	42431
London	Plain	Temperate oceanic	8603000	82.63	35.10	58830
New York	Plain	Humid subtropical	8427000	82.70	55.10	81106
Paris	Basin	Oceanic	2206000	79.66	32.70	53700

4.1. Degree of similarity in urban features

Based on the similarity measure stated in Section 3.1, urban features of the six reference cities and Beijing are collected from the Municipal Bureau of Statistics, World Bank, the website of Statista and Wikipedia, as shown in Table 1. The reference year is selected as 2015 in consistency with the following measurement while representing the situation before the start of Beijing's 13th Five-Year Plan for Transportation.

By applying Eq. (1) and Eq. (2) to corresponding data in Table 1, the results of similarity analysis are obtained, as shown in Table 2. The weighting values between the six urban characteristics are evenly distributed, the same as Shen et al. (2017). Accordingly, the integrated and normalized similarities are calculated using Eq. (3) and Eq. (4), respectively, as shown in the last two columns in Table 2. It is suggested that among the selected cities, Seoul is the most similar city to Beijing considering the six urban characteristics, while London is slightly lower in similarity to it.

4.2. Degree of feasibility

Consistent with the integrated framework in Fig. 1, this study further uses indicator systems and survey research to evaluate the degrees of the feasibility of the six reference cities. As the study aims to elaborate on the effectiveness of the integrated conceptual framework, the demonstration uses existing evaluation studies to triangulate rather than make a fresh start of urban transition evaluation, as previous specialized research has provided a thorough examination from their perspectives. Since all the materials used in this study are accessible publicly, the demonstration could also apply to other scenarios.

4.2.1. Transition performance by indicator system

Sustainable Cities Mobility Index by Arcadis (2017) and an urban transportation system study by Knupfer et al. (2018) has established indicator systems to evaluate the transport sustainability of global cities from multiple dimensions and score each city based on their performance. Both studies include the six case cities and provide complementary angles of their sustainability transition performance. Arcadis (2017) measures the environmental performance of 100 cities, using indicators such as greenhouse gas emissions per capita from transport, green space as a share of city area, increase in overall travel time, bicycles per capita, PM 10 and PM 2.5 levels, vehicle emission standards, provision of incentives to purchase EV. Knupfer et al. (2018) develop indicators to assess the sustainability of urban mobility in 23 representative metropolises, including number of road and public transport casualties, safety enforcement index, average age of vehicles on the road, diesel and gasoline fuel standards, share of electric vehicles, machine hours worked per square kilometers. While Arcadis (2017) assesses sustainability from climate change mitigation, air quality management, and green transport modes, Knupfer et al. (2018) focus on road safety and their readiness for a sustainable transition. Hence, combining the two studies can provide a more comprehensive understanding of the sustainability performance of the six reference cities.

Fig. 2 shows the integrated performance ratings of each reference city, which is the average of the normalized scores based on the sustainability assessment in Arcadis (2017) and Knupfer et al. (2018). It is illustrated that Singapore is ranked first and performs equally well in the two studies while Paris is slightly below. However, Seoul and New York scored lowest, which are very opposite to their rankings in the similarity analysis. Considering the transition performance assessed by objective indicators, Singapore would be the most suitable city for Beijing to learn from, unlike the similarity measures of urban characteristics.

4.2.2. Transition performance by survey research

Unlike the indicator system, survey research focuses on the subjective feelings of residents towards the sustainability of the urban transportation system. Knupfer et al. (2018) investigate the residential satisfaction with the overall situation and recent changes in transport sustainability, used in this study as another evaluation method for transition performance. Fig. 3(a) represents the ranking of the reference cities among the 23 metropolises in Knupfer et al. (2018), concerning the residential satisfaction of reference cities with environmental impacts by the urban transport system. It is shown that residents in Singapore are most satisfied with both the current situation and changes in environmental impacts of the mobility system. In contrast, residents in Paris are rather skeptical, although its objective performance is among the highest according to Section 4.2.1. The satisfaction of Seoul residents with the environmental benefits of the transportation system is consistent with the objective performance, both of which are undesirable. Moreover, residents in London and New York recognize the ecological sustainability of the current mobility system but still see room for improvement and are relatively conservative about the changes in this aspect.

Combining residents' satisfaction percentages with the current situation and changes in sustainability, Fig. 3(b) represents

Table 2
Similarity levels of the mined cities concerning urban features.

City	S1	S2	S3	S4	S5	S6	Integrated similarity	Normalized similarity
Singapore	1	0	0.207	0.607	0.712	0.398	0.483	0.858
Seoul	1	0	0.462	0.808	0.332	0.818	0.563	1.000
Hong Kong	0	0	0.307	0.536	0.692	0.604	0.358	0.635
London	1	0	0.386	0.844	0.556	0.348	0.519	0.922
New York	1	0	0.375	0.846	0.644	0.000	0.477	0.847
Paris	1	0	0.000	0.738	0.460	0.428	0.432	0.767

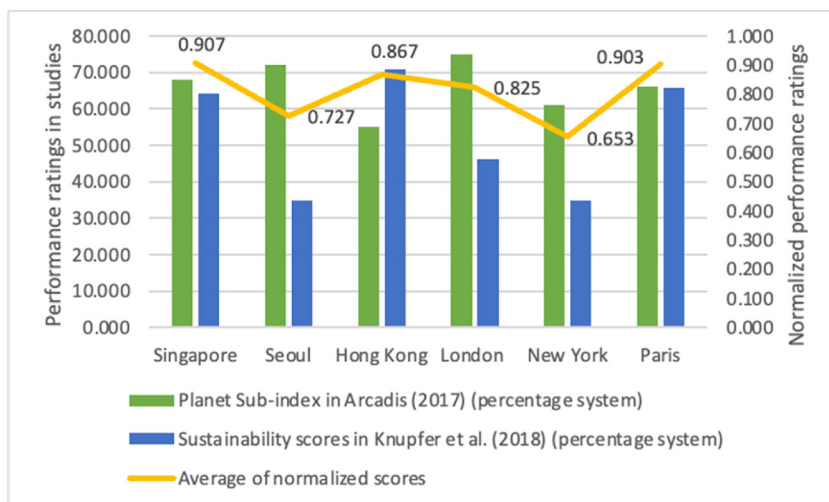


Fig. 2. Sustainable transition performance of reference cities by indicator systems.

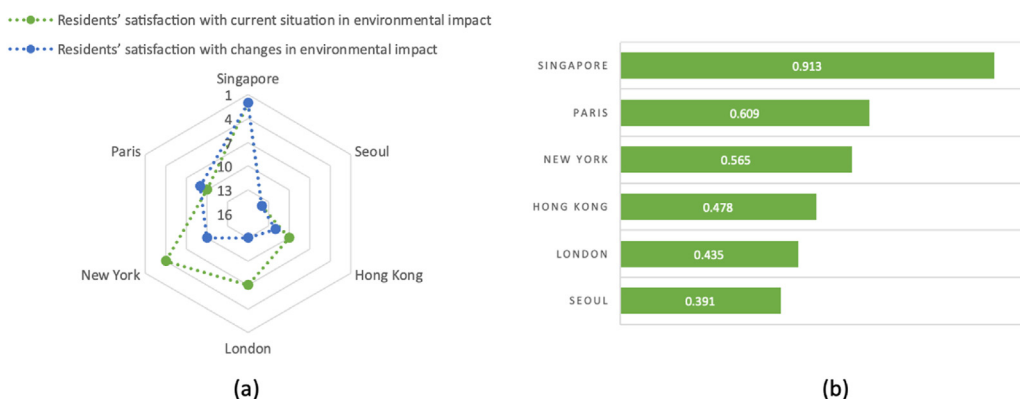


Fig. 3. (a) Ranking of residents' satisfaction with the current situation and changes in sustainability; (b) Normalized satisfaction rates of the reference cities.

Table 3
Comparative analysis of contextual factors between Beijing and reference cities.

Beijing		Singapore	Seoul	Hong Kong	London	New York	Paris
Main driving forces	High travel demand	☑		☑	☑	☑	☑
	Traffic congestion	☑	☑				
	Urban density			☑	☑		☑
	Technology development						
	Regional development					☑	
Visions	Technology-driven	☑		☑		☑	
	Low carbon	☑	☑			☑	☑
	Human-oriented		☑		☑		
	Road safety				☑	☑	
	Accessible	☑		☑	☑	☑	
Public transport ownership and operation	Publicly owned	☑		☑	☑	☑	☑
	Publicly operated	☑					☑
Summarized degrees		6.667	2.000	4.333	5.000	5.667	5.333
Normalized degrees		1.000	0.300	0.649	0.750	0.850	0.800

Notes: ☑ represents the city is the same as Beijing.

Sources: May, 2004; Tang & Lo, 2008; Litman, 2011; Lee et al., 2015; Diao, 2019; Greater London Authority, 2018; Halpern & Le Galès, 2016; New York City Department of Transportation, 2016.

normalized satisfaction rates of each reference city, where citizens of cities below 0.5 are dissatisfied with the environmental impact of the transportation system. Singapore remains the most feasible city for experience learning in terms of both objective transition performance and subjective residential attitudes.

4.3. Degree of applicability

Referring to a context comparison carried out by Peng et al. (2019), this paper compares several key policy settings behind the transition towards sustainable transport between the reference cities and Beijing, as illustrated in Table 3. Three dimensions are identified as significant contextual factors for facilitating transitions in urban mobility system, namely main driving forces (Steurer & Bonilla, 2016), visions (Tight et al., 2011) and public transport ownership and operation (Roy & Yvrande-Billon, 2007). The comparative analysis is conducted by examining whether the past practices share the same factors with Beijing. The policy context of Beijing is based on Beijing’s 13th Five-Year Plan on transportation (2016), which articulates its commitment to sustainable transformation. For demonstration, each dimension is allocated with the same weighting values and its sub-dimensions account for the same percentage of the dimension to which they belong.

As shown in Table 3, Singapore has the most similar contextual factors to Beijing, while Seoul shares the lowest, indicating that Singapore would have the minimum contextualization barriers for experience transfer and therefore represents the most applicable practice to Beijing given policy contexts.

4.4. Integrated degree of matching

Following the Eq. (7), integrated matching degrees are calculated for each reference city. Fig. 4 depicts the integrated degree of matching for each city after triangulating urban features similarity measure, transition performance indicator system, residential satisfaction survey, and comparative analysis of policy contexts. It shows that Singapore becomes the best match regarding the similarity, feasibility and applicability, while Seoul, which has the highest similarity under the original ExMS, has the lowest score after considering multiple dimensions. Compared with the results in the previous ExMS, as represented in Table 2, Singapore has a much higher integrated degree of matching than other cities, while there are no such significant differentiation in the similarity analysis.

5. Discussion

According to the demonstration, Singapore is the best match for Beijing among the six selected cities from the perspective of urban features, transition performance and policy contexts. In reality, there are significant overlaps between Singapore’s past practices and the transport policies launched by Beijing for a sustainable transition. Singapore has introduced Vehicle Quota System (VQS) since 1990 to control car ownership (Chu, 2018). Under this scheme, a resident is required to obtain a Certificate of Entitlement via a competitive bidding system before buying a new car. In addition to controlling the vehicle population, Singapore has actively expanded its public transport system to meet the increasing travel needs of residents, which consists of the Mass Rapid Transit System, the Light Rail Transit system, bus services and taxis (Diao, 2019). Nevertheless, Singapore has integrated land use and transport planning to encourage the use of public transport, which is supported by an increasingly smart transport system. Beijing has also proposed similar policies for a sustainable mobility system. For instance, it has implemented the license plate lottery policy to allocate a fixed number of vehicle purchase permits each year at a random rule, which is not exactly the same as the VQS but shares the same logic for restricting car

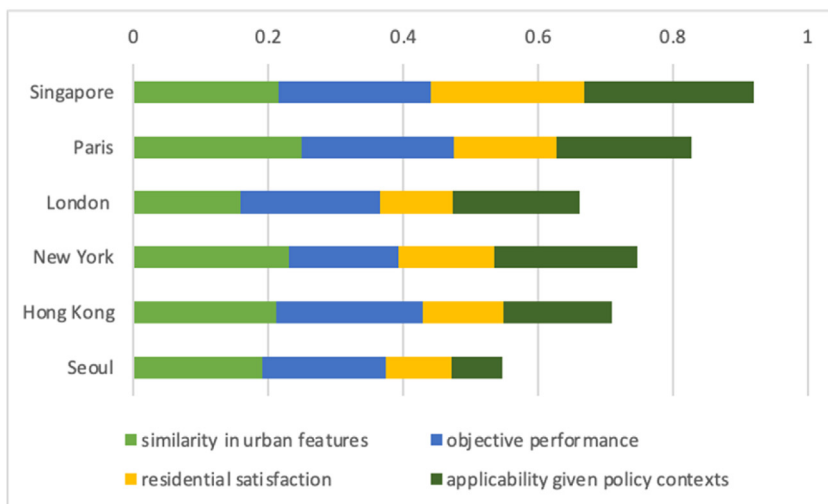


Fig. 4. Integrated degree of matching.

ownership. Moreover, increasing the coverage and connectivity of public transport such as rail transit and bus systems has been prioritized in Beijing's 13th Five-Year Plan for [Beijing Municipal Commission of Transportation \(2016\)](#) and 14th Five-Year Plan for Significant Infrastructure ([The People's Government of Beijing Municipality, 2022](#)). Additionally, Beijing also tends to enable seamless travel in public transport by smart technology and collects a vast amount of information for integrated land use and transport planning. These facts are generally echoed by the results generated from the integrated framework. Especially since Singapore has been a significant overseas destination for study visits and experience learning by Chinese officials, it is reasonable to recommend Singapore as a good experience for Beijing to promote sustainable transportation.

It is shown that the integration with triangulation leads to substantially different results compared to the original ExMS. By seeking to establish traditional forms of rigor, triangulation is frequently predicated on convergent outcomes. However, such convergence risks limiting the discussion to those points in the study that can be corroborated, thereby missing some of the insights that triangulation is intended to reveal ([Farquhar et al., 2020](#)). Divergence of results frequently occurs in previous research that applies triangulation to study a specific phenomenon ([Ammenwerth et al., 2003](#); [Camburn & Barnes, 2004](#); [Farquhar et al., 2020](#); [Modell, 2015](#)). It is perceived that divergence can play a significant role in enhancing rigor and adding credibility to the study. It can uncover unseen factors and lead to clearer definitions and theoretical elaboration ([Davis et al., 2011](#); [Farquhar et al., 2020](#)). Generally, the integration of triangulation can improve the case retrieval process of ExMS from the following aspects.

5.1. Increasing construct validity of the research design

Construct validity refers to the extent to which the operational definition and measure of the empirical phenomenon indicate the theoretical construct ([Modell, 2005](#)). Suppose triangulated research enhances the fit between conceptual apparatus and empirical data by using multiple sources of evidence to investigate the same phenomenon. In that case, it is suggested to improve the construct validity of the research design ([Yin, 2009](#)). The case retrieval mechanism in the original ExMS is based on the concept that past practices with similar problem nature and urban features can provide valuable solutions for the target city. While these two factors are proved critical in previous studies, transition performance and policy contexts also play significant roles in enabling successful experience transfer, according to existing urban transition theory ([Mendizabal et al., 2018](#); [Nagorny-Koring & Nochta, 2018](#); [Nevens et al., 2013](#)).

The case retrieval process of the existing ExMS is based on the part of the theoretical construct, while some significant dimensions are neglected. Though it is impractical to address so many questions with a single evaluation method, triangulation can enable ExMS to complement measurement instruments for a more comprehensive assessment of the plausible experiences. By leading to an adequate reflection of theoretical concepts of experience learning in urban transition, the integrated framework of ExMS and triangulation can improve the construct validity of the existing ExMS and increase the meticulousness of the research design.

5.2. Enhancing the credibility of experience mining results

Credibility refers to the extent to which the research findings are believable and appropriate, which depends on the richness of the information rather than the amount of collected data ([Cope, 2014](#)). Generally, the findings would be more credible if they were examined by multiple complementary sources instead of a single source, indicating a more comprehensive understanding of the phenomenon and, therefore a higher level of trustworthiness ([Patton, 1999](#)). Since different sources of information tend to have specific focus and limitations, relying on any one of them would lead to cognitive biases.

In the integrated framework of ExMS and triangulation, the degree of matching between the target city and reference cities is evaluated by indicator systems, survey research, comparative analysis of contextual factors and similarity measures. Each method examines the transferability of past experiences from a different facet and therefore comprises a complementary mode of triangulation, which can gain a better picture of the previous practices and enhance the credibility of experience mining results ([Crump & Logan, 2008](#)).

The complementarity can contribute to the credibility of the research findings, regardless of the consistency of triangulated results. If the overall patterns of data from different sources are convergent, the triangulation would significantly enhance the credibility of experience mining. As shown in the demonstration, Singapore was continuously selected as the most suitable city for Beijing to learn from, considering either the objective performance of the transition, the subjective feelings of the residents, or the similarity of the policy contexts. The convergence across the three dimensions indicates that the triangulated results are robust to some extent and therefore prove higher credibility compared with the existing ExMS.

However, divergence frequently makes appearances in mixed methods research. Such inconsistencies ought not to be perceived as weakening the credibility of results, as these complementary approaches investigate the phenomenon from different perspectives and thus are incommensurable with each other. As shown in the demonstration, despite the results of these dimensions being divergent with similarity measures of urban characteristics, they still have higher credibility than the existing ExMS due to the increased completeness of the evaluation results in case retrieval. Moreover, such divergence provides opportunities for deeper insight into the factors influencing experience learning in urban transition and their differences in significance level, provoking reflections on related theories.

5.3. Maintaining practicability for decision-makers

Although the increased dimensionality in the triangulation can improve the construct validity and credibility of the existing ExMS, it also raises its complexity for real-world application. When the dimensionality rises, the amount of data required also grows exponentially to obtain a reliable outcome. This problem is referred to as the curse of dimensionality, which frequently occurs in data mining

(Verleyesen & François, 2005). The dimensionality to evaluate experience transferability should be kept in a moderate range to avoid such a problem. Otherwise, it would undermine validity in turn. Therefore, this integrated framework includes only the most significant dimensions in facilitating successful experience learning for urban transition, based on previous literature. As shown in the demonstration, the framework can be applied using publicly available data and existing studies, indicating its practicability for policymakers while improving the validity and credibility of experience mining.

It is noteworthy that this study intends not to generate a standardized research design but to provide a research strategy that can be tailored to specific objectives and questions. The integrated framework can leverage more triangulation facets than depicted in the current research by triangulating different data sources, methods, researchers, and theories. In addition to the complementary inferences illustrated in this study, three additional types of inferences can be further developed for experience sharing in urban transitions: (a) convergent inference: to find common hypotheses supported by all the triangulated findings, which may strengthen a proposition or a theory of urban transitions; (b) divergent inference: lead to serendipitous findings or theory development based on dissonance or inconsistency in triangulated results; (c) meta inference: generate higher levels of theories by reflecting on general findings. For example, the integrated framework can help future research establish a framework of relationships between performance, social impacts, drivers, visions, and policy support of urban transitions.

6. Conclusion

While experience mining system (ExMS) can serve as a smart decision support system for urban transitions, its current case retrieval process only considers the similarity of problem nature and urban features and neglects the feasibility and applicability of the experiences. According to existing research, the neglect of these two dimensions could lead to ineffective experience learning and eventually fails to solve urban challenges. To address the issue, this study proposes an integrated framework of ExMS and methodology triangulation to modify the previous case retrieval process and improve the validity and credibility of experience mining. This framework combines multiple methodologies to evaluate experience transferability from different perspectives, including indicator systems for quantifying objective performance, survey research for evaluating residential satisfaction, comparative analysis for examining contextual factors and similarity measures of urban features. Under this framework, an integrated degree of matching is generated to compare the suitability of past experiences for the target cities.

By applying the framework to a scenario target—Beijing, the study further demonstrates its procedures in identifying the best match. The divergence between the results of the existing ExMS and methodology triangulation suggests that the similarity in urban backgrounds is insufficient to show the degree of matching between the case cities and the target city. By examining the experience transferability from different complementary perspectives, the integrated framework has yielded a richer and more holistic picture of these past practices, thereby leading to a higher level of credibility. Moreover, compared with the existing ExMS, the integrated framework is more indicative of the theoretical construct of experience learning in urban transitions and, therefore, improves the construct validity of the research design while maintaining a reasonable dimensionality to ensure practicability for decision-makers.

The paper still leaves several questions for the future. First of all, the demonstration is based on simulated experience mining systems and therefore is inevitably hard to reflect actual operational problems. The integrated framework could become truly constructive only when a functional experience mining system is launched and adopted in reality. Secondly, while the paper triangulates different methods to calculate a weighted degree of matching for other cities compared with the target city, the weighting value of each method is significant for the final result. In this study, all the methods are equally weighted, which is a simplification ignoring the importance of different methods in this framework. Future research can further study the weight allocation for triangulation and how it affects research findings.

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.

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References

- Affolderbach, J., & Schulz, C. (2016). Mobile transitions: Exploring synergies for urban sustainability research. *Urban Studies*, 53(9), 1942–1957.
- Akter, S., Hakim, S. S., & Rahman, M. S. (2021). Planning for pandemic resilience: COVID-19 experience from urban slums in khulna, Bangladesh. *Journal of Urban Management*, 10(4), 325–344.
- Ali-Toudert, F., Ji, L., Fährmann, L., & Czempik, S. (2019). Comprehensive assessment method for sustainable urban development (CAMSUD)-A new multi-criteria system for planning, evaluation and decision-making. *Progress in Planning*, 140, 100430.
- Ammenwerth, E., Iller, C., & Mansmann, U. (2003). Can evaluation studies benefit from triangulation? A case study. *International Journal of Medical Informatics*, 70(2–3), 237–248.
- Arcadis. (2017). Sustainable cities mobility index 2017: Bold moves. Available online <https://www.arcadis.com/en/global/our-perspectives/sustainable-cities-mobility-index-2017/>. (Accessed 25 December 2021).

- Beijing Municipal Commission of Transportation. (2016). Beijing's 13th five-year plan for transportation. Available online (in Chinese) <http://jtw.beijing.gov.cn/>. (Accessed 25 December 2021) Accessed.
- Booth, W. C., Colomb, G. G., & Williams, J. (2018). *Approaches to social research*. Chicago, IL: University of Chicago Press.
- Camburn, E., & Barnes, C. A. (2004). Assessing the validity of a language arts instruction log through triangulation. *The Elementary School Journal*, 105(1), 49–73.
- Campbell, R., Goodman-Williams, R., Feeney, H., & Fehler-Cabral, G. (2020). Assessing triangulation across methodologies, methods, and stakeholder groups: The joys, woes, and politics of interpreting convergent and divergent data. *American Journal of Evaluation*, 41(1), 125–144.
- Chu, S. (2018). Singapore's Vehicle Quota System and its impact on motorcycles. *Transportation*, 45(5), 1419–1432.
- Cope, D. G. (2014). Methods and meanings: Credibility and trustworthiness of qualitative research. *Oncology Nursing Forum*, 41(No. 1).
- Crump, B., & Logan, K. (2008). A framework for mixed stakeholders and mixed methods. In *Proceedings of the 7th European conference on research methodology for business and management studies: ECRM2008* (p. 111). Academic Conferences Limited.
- Davis, D. F., Golicic, S. L., & Boerstler, C. N. (2011). Benefits and challenges of conducting multiple methods research in marketing. *Journal of the Academy of Marketing Science*, 39(3), 467–479.
- Denzin, N. K. (1978). Triangulation: A case for methodological evaluation and combination. *Sociological methods*, 339–357.
- Denzin, N. K. (2017). *Sociological methods: A sourcebook*. New York: Routledge.
- Deus, R. M., Mele, F. D., Bezerra, B. S., & Battistella, R. A. G. (2020). A municipal solid waste indicator for environmental impact: Assessment and identification of best management practices. *Journal of Cleaner Production*, 242, 118433.
- Diao, M. (2019). Towards sustainable urban transport in Singapore: Policy instruments and mobility trends. *Transport Policy*, 81, 320–330.
- El-Fakdi, A., Gamero, F., Melendez, J., Auffret, V., & Haigron, P. (2014). eXITCDSS: A framework for a workflow-based CBR for interventional Clinical Decision Support Systems and its application to TAVI. *Expert Systems with Applications*, 41(2), 284–294.
- Erfani, G. (2020). Sense of place as an investigative method for the evaluation of participatory urban redevelopment. *Cities*, 99, 102648.
- Farquhar, J., Michels, N., & Robson, J. (2020). Triangulation in industrial qualitative case study research: Widening the scope. *Industrial Marketing Management*, 87, 160–170.
- Forrest, N., & Wiek, A. (2014). Learning from success—toward evidence-informed sustainability transitions in communities. *Environmental Innovation and Societal Transitions*, 12, 66–88.
- Greater London Authority. (2018). Mayor's transport strategy. Available online <https://www.london.gov.uk/sites/default/files/mayors-transport-strategy-2018.pdf>. (Accessed 25 December 2021).
- Halpern, C., & Le Galès, P. (2016). *Transformative urban transport and the making of an urban regional mode of governance: The case of Paris and the ile-de-France region*. Transforming Urban Transport—The Role of Political Leadership" Research Project.
- Hodson, M., Marvin, S., & Bulkeley, H. (2013). The intermediary organisation of low carbon cities: A comparative analysis of transitions in greater London and greater Manchester. *Urban Studies*, 50(7), 1403–1422.
- Hordijk, M., Sara, L. M., & Sutherland, C. (2014). Resilience, transition or transformation? A comparative analysis of changing water governance systems in four southern cities. *Environment and Urbanization*, 26(1), 130–146.
- Huang, Z., Fan, H., & Shen, L. (2019). Case-based reasoning for selection of the best practices in low-carbon city development. *Frontiers of Engineering Management*, 6(3), 416–432.
- Jain, A., Nandakumar, K., & Ross, A. (2005). Score normalization in multimodal biometric systems. *Pattern Recognition*, 38(12), 2270–2285.
- Jnr, B. A. (2021). A case-based reasoning recommender system for sustainable smart city development. *AI & Society*, 36(1), 159–183.
- Kern, F. G. (2018). The trials and tribulations of applied triangulation: Weighing different data sources. *Journal of Mixed Methods Research*, 12(2), 166–181.
- Knupfer, S. M., Pokotilo, V., & Woetzel, J. (2018). *Elements of success: Urban transportation systems of 24 global cities*. New York - McKinsey & Company. Available online <https://www.mckinsey.com/business-functions/sustainability/our-insights/elements-of-success-urban-transportation-systems-of-24-global-cities>. (Accessed 25 December 2021).
- Krosnick, J. A. (1999). Survey research. *Annual Review of Psychology*, 50(1), 537–567.
- Lee, C., Sung, N. M., Choi, S. D., Yi, E. J. A., & Lee, S. (2015). *Korea's leap forward in green transport (transport and ICT connections note no. 15)*. Washington, DC - World Bank Group. Available online <http://pubdocs.worldbank.org/en/756281430247492763/TransportICT-Newsletter-Note15-v2.pdf>. (Accessed 25 December 2021).
- Legrand, T. (2012). Overseas and over here: Policy transfer and evidence-based policy-making. *Policy Studies*, 33(4), 329–348.
- Litman, T. (2011). *London congestion pricing: Implications for other cities*. Victoria Transport Policy Institute. Available online <https://www.vtpi.org/london.pdf>. (Accessed 25 December 2021).
- López, B., Pous, C., Gay, P., Pla, A., Sanz, J., & Brunet, J. (2011). eXIT* CBR: A framework for case-based medical diagnosis development and experimentation. *Artificial Intelligence in Medicine*, 51(2), 81–91.
- Malek, J., & Desai, T. N. (2020). A systematic literature review to map literature focus of sustainable manufacturing. *Journal of Cleaner Production*, 256, 120345.
- Marquez-Ballesteros, M. J., Mora-López, L., Lloret-Gallego, P., Sumper, A., & Sidrach-de-Cardona, M. (2019). Measuring urban energy sustainability and its application to two Spanish cities: Malaga and Barcelona. *Sustainable Cities and Society*, 45, 335–347.
- May, A. D. (2004). Singapore: The development of a world class transport system. *Transport Reviews*, 24(1), 79–101.
- McCaann, E. (2011). Urban policy mobilities and global circuits of knowledge: Toward a research agenda. *Annals of the Association of American Geographers*, 101(1), 107–130.
- Mendizabal, M., Heidrich, O., Feliu, E., García-Blanco, G., & Mendizabal, A. (2018). Stimulating urban transition and transformation to achieve sustainable and resilient cities. *Renewable and Sustainable Energy Reviews*, 94, 410–418.
- Modell, S. (2005). Triangulation between case study and survey methods in management accounting research: An assessment of validity implications. *Management Accounting Research*, 16(2), 231–254. <https://doi.org/10.1016/j.mar.2005.03.001>
- Modell, S. (2015). Theoretical triangulation and pluralism in accounting research: A critical realist critique. *Accounting, Auditing & Accountability Journal*, 28(7), 1138–1150.
- Nagorny-Koring, N. C., & Nocht, T. (2018). Managing urban transitions in theory and practice-The case of the Pioneer Cities and Transition Cities projects. *Journal of Cleaner Production*, 175, 60–69.
- Neuens, F., Frantzeskaki, N., Gorissen, L., & Loorbach, D. (2013). Urban transition labs: Co-creating transformative action for sustainable cities. *Journal of Cleaner Production*, 50, 111–122.
- New York City Department of Transportation. (2016). Strategic plan 2016: Safe + green + smart + equitable. Available online <https://www.nycdotplan.nyc/sites/default/files/2017-07/Strategic-plan-2016.pdf>. (Accessed 25 December 2021).
- New York State Department of Transportation. (2006). *Strategies for a new age: New York state's transportation master plan for 2030*. Available online <https://www.dot.ny.gov/portal/page/portal/main/transportation-plan/repository/masterplan-111406.pdf>. (Accessed 18 April 2022).
- Ochoa, J. J., Tan, Y., Qian, Q. K., Shen, L., & Moreno, E. L. (2018). Learning from best practices in sustainable urbanization. *Habitat International*, 78, 83–95.
- Orlowski, C., Ziolkowski, A., Orlowski, A., Kaptaniński, P., Sitek, T., & Pokrzywnicki, W. (2016). Smart cities system design method based on case based reasoning. In *Transactions on computational collective intelligence XXV* (pp. 43–58). Berlin, Heidelberg: Springer.
- Patton, M. Q. (1999). Enhancing the quality and credibility of qualitative analysis. *Health Services Research*, 34(5 Pt 2), 1189.
- Peng, Y., Wei, Y., & Bai, X. (2019). Scaling urban sustainability experiments: Contextualization as an innovation. *Journal of Cleaner Production*, 227, 302–312.
- Pereira, I., & Madureira, A. (2013). Self-optimization module for scheduling using case-based reasoning. *Applied Soft Computing*, 13(3), 1419–1432.
- Pike, E. (2010). Congestion charging: challenges and opportunities. The International Council on Clean Transportation. Available online https://theicct.org/sites/default/files/publications/congestion_apr10.pdf. (Accessed 19 May 2022).
- Reisi, M., Sabri, S., Agunbiade, M., Rajabifard, A., Chen, Y., Kalantari, M., Keshtiarast, A., & Li, Y. (2020). Transport sustainability indicators for an enhanced urban analytics data infrastructure. *Sustainable Cities and Society*, 59, 102095.

- Roy, W., & Yvrande-Billon, A. (2007). Ownership, contractual practices and technical efficiency: The case of urban public transport in France. *Journal of Transport Economics and Policy*, 41(2), 257–282.
- Sanderson, I. (2002). Evaluation, policy learning and evidence-based policy making. *Public Administration*, 80(1), 1–22.
- Shefer, I. (2019). Policy transfer in city-to-city cooperation: Implications for urban climate governance learning. *Journal of Environmental Policy and Planning*, 21(1), 61–75.
- Sheldrick, A., Evans, J., & Schliwa, G. (2016). Policy learning and sustainable urban transitions: Mobilising Berlin's cycling renaissance. *Urban Studies*, 54(12), 2739–2762.
- Shen, L. Y., Ochoa, J. J., Shah, M. N., & Zhang, X. (2011). The application of urban sustainability indicators—A comparison between various practices. *Habitat International*, 35(1), 17–29.
- Shen, L. Y., Ochoa, J. J., Zhang, X., & Yi, P. (2013). Experience mining for decision making on implementing sustainable urbanization—an innovative approach. *Automation in Construction*, 29, 40–49.
- Shen, L., Yan, H., Fan, H., Wu, Y., & Zhang, Y. (2017). An integrated system of text mining technique and case-based reasoning (TM-CBR) for supporting green building design. *Building and Environment*, 124, 388–401.
- Shen, L., Yan, H., Zhang, X., & Shuai, C. (2017). Experience mining based innovative method for promoting urban sustainability. *Journal of Cleaner Production*, 156, 707–716.
- Sheng, M., Hu, L., Zhang, B., Deng, L., & Zhao, Y. (2021). Housing tenure and neighbourhood satisfaction in transitional urban China: Evidence from Changchun. *Habitat International*, 112, 102358.
- Steurer, N., & Bonilla, D. (2016). Building sustainable transport futures for the Mexico city metropolitan area. *Transport Policy*, 52, 121–133.
- Tang, S., & Lo, H. K. (2008). The impact of public transport policy on the viability and sustainability of mass railway transit—The Hong Kong experience. *Transportation Research Part A: Policy and Practice*, 42(4), 563–576.
- Temelová, J., & Dvořáková, N. (2012). Residential satisfaction of elderly in the city centre: The case of revitalizing neighbourhoods in Prague. *Cities*, 29(5), 310–317.
- The People's Government of Beijing Municipality. (2022). *Beijing's 14th five-year plan for significant infrastructure development*. Available online (in Chinese) http://www.beijing.gov.cn/zhengce/zhengcefagui/202203/t20220303_2621094.html/. (Accessed 19 April 2022).
- Tight, M., Timms, P., Banister, D., Bowmaker, J., Copas, J., Day, A., ... Watling, D. (2011). Visions for a walking and cycling focussed urban transport system. *Journal of Transport Geography*, 19(6), 1580–1589.
- Toh, R. S., & Phang, S. Y. (1997). Curbing urban traffic congestion in Singapore: a comprehensive review. *Transportation Journal*, 37(2), 24–33.
- Verleysen, M., & François, D. (2005). June). The curse of dimensionality in data mining and time series prediction. In *International work-conference on artificial neural networks* (pp. 758–770). Berlin, Heidelberg: Springer.
- Wang, Q., Berlin, D., & Meijer, S. (2019). Uncovering stakeholder influences in electric road systems using two assessment methods: The case of eRoadArlanda. *Research in Transportation Business & Management*, 33, 100422.
- Wang, J., Shen, L., Ren, Y., J. J., Guo, Z., Yan, H., & Wu, Z. (2019). A lessons mining system for searching references to support decision making towards sustainable urbanization. *Journal of Cleaner Production*, 209, 451–460.
- Wu, Y., Shuai, C., Wu, L., Shen, L., Yan, J., Jiao, L., & Liao, S. (2020). A new experience mining approach for improving low carbon city development. *Sustainable Development*, 28(4), 922–934.
- Xu, M., Grant-Muller, S., & Gao, Z. (2017). Implementation effects and integration evaluation of a selection of transport management measures in Beijing. *Case Studies on Transport Policy*, 5(4), 604–614.
- Yeh, A. G. O., & Shi, X. (1999). Applying case-based reasoning to urban planning: A new planning-support system tool. *Environment and Planning B: Planning and Design*, 26(1), 101–115.
- Yin, R. K. (2009). *Case study research: Design and methods* (Vol. 5). sage.
- Zhao, P., & Hu, H. (2019). Geographical patterns of traffic congestion in growing megacities: Big data analytics from Beijing. *Cities*, 92, 164–174.
- Zhou, Y., Lan, F., & Zhou, T. (2021). An experience-based mining approach to supporting urban renewal mode decisions under a multi-stakeholder environment in China. *Land Use Policy*, 106, 105428.