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Analysis and Evaluation of the Service Capacity of a Waterfront Public Space Using Point-of-Interest Data Combined with Questionnaire Surveys

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Abstract: The analysis and evaluation of the service capacity of an urban public space is of great importance for optimizing spatial design and ensuring sustainable regeneration of the space. Point-of-interest (POI) data analysis is a common method for evaluating the performance of public space since it contains various geographical information about specific facilities. However, this method is incapable of providing intuitive and clear feedback on the usage of the space, such as visitor experience and satisfaction levels. In this paper, we present a hybrid approach that combines POI data with questionnaire surveys to comprehensively analyze and evaluate the service capacity of the facilities in a waterfront public space. By taking the Changning section of the Suzhou Creek in Shanghai as an example, we evaluate and verify the utilization rate and satisfaction level of public facilities based on this hybrid approach with three satisfaction factors: accessibility, landscape visual quality, and service functions. The results reveal that the service space that can be reached on foot provides the most satisfaction in terms of accessibility, followed by the space that can be reached by bicycle. When it comes to landscape visual quality, visitors are more concerned with the view around the facility than with the greenery. Regarding service functions, the service facility with beverage outlets, fitness, and small gatherings is more appealing. The proposed approach will be useful for further developing advanced public space evaluation strategies with real-time feedback capabilities, as well as for the intelligent design and long-term regeneration of future public spaces.

Keywords: urban public space; waterfront; service capacity; POI data; questionnaire surveys

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1. Introduction

With the transition of urban spaces from the incremental era to the inventory era, sustainable improvement of the quality and livability of the spaces is of great importance in urban development [1,2]. Public service facilities are a type of fundamental urban spaces closely related to citizens' life. To improve the livability of the cities, rational planning and optimization of the spatial distribution and service capacity of public service facilities are highly desirable. During the current urban spatial planning, digital technologies, such as Point of Interest (POI), Geographic Information Science (GIS), and Ripley's K functionalization, have been widely used, which provide massive data to support spatial design and evaluation of public service facilities [3–5]. Among many digital technologies, POI data analysis, as a representative spatial analysis method, has the advantages of broad coverage, large data volume, and high accuracy [6–8]. Through the POI data analysis and other digital resources, the distribution density of urban service facilities can be easily identified. Meanwhile, the vitality index and spatial distribution of public spaces in different cities can be compared [9,10]. By doing this, urban planning and construction strategies can be further optimized.

Today, the POI data analysis method has been extensively used to investigate spatial vitality index, spatial pattern relationship, and economic impact factors in urban space planning. Regarding spatial vitality, the statistical results of POI and GIS data showed that

constructing sites with dense distribution of service facilities was beneficial for promoting the vitality index [11,12]. Moreover, with POI data analysis, recreational green spaces with a dense layout of service facilities and a strong functional correlation exhibited a superior vibrancy index and convenience of the urban public space [13]. In addition, through the POI data analysis, the waterfront vitality zoning was largely influenced by the facility layout of the environment [14,15]. Regarding urban spatial patterns, the disparity issues between the demand for facilities and the needs of residents were discussed based on the combination of POI data and population size [16,17]. By evaluating the spatial measurement of the distribution of public service facilities in Shanghai and Beijing, the results revealed that the matching degree of service facility on demand in both cities decreased from the city center to the suburbs. Regarding economic characteristics, the Relationship between walkability and the alignment of diverse socio-economic indicators of neighborhoods was explored, and related optimization strategies for urban resource equity were proposed [18]. In addition, comparative analysis results of the travel mode of the community and the surrounding urban functions showed that the communities with higher walkability of service facilities correspond to a higher level of economic income among community residents [19,20]. However, most of the work on the POI data analysis was at a city-level scale from a geographical perspective, which suffers from the issues of large sample sizes and single statistical values. Precise evaluation of the service capacity of a specific site from the single POI data and identification of the key issues in space design remains a challenge [21,22]. For instance, through POI data analysis, although the spatial correlation and hotspot detection information about various facilities of interest in a Wuhan waterfront space could be obtained [23], the whole service capacities of those facilities have not been evaluated.

A questionnaire survey is a common way to collect data in the social sciences [24]. As a reliable method, the questionnaire survey provides statistical analysis results of the answers of the respondents through the refinement of specific questions. This method has been used in urban public space planning and design to investigate the satisfaction, rest demand, health perception, and mechanism evaluation of urban parks and urban green spaces [25]. It is also required in a site analysis to understand the evaluation of space utilization. However, the sole questionnaire survey has some limitations in evaluating some service spaces with "strong subjective feelings", and some potential choices cannot be sufficiently reflected in limited multiple-choice questions. Although it can directly judge the single questions of "satisfactory" and "unsatisfactory", it is difficult to identify specific design problems and influencing factors. For example, in the analysis of visitor satisfaction in garden tours, although the score of space satisfaction can be intuitively obtained [26], the underlying spatial design issues and influencing factors in low-satisfaction conditions have not been revealed. The insufficiency of the questionnaire survey can be compensated by the POI data analysis that can directly measure the geographical layout and frequency of the utilization of public service spaces through big data. Therefore, through the combination of the POI data and questionnaire surveys, not only can usage efficiency information about service space be real-time collected by the big data, but also real feedback evaluation of visitor needs can be obtained through surveys [27–29].

In this paper, we present a hybrid approach that combines POI data analysis with questionnaire surveys to comprehensively analyze and evaluate the service capacity of the facilities in a waterfront public space. Firstly, POI data was collected from public service facilities at ten service facility sites in the Changning section of the Suzhou Creek in Shanghai. These POI data include the number, density, and spatial distribution of five types of public service spaces, including tourist service centers, health facilities, emergency service facilities, cultural stations, and neighborhood centers. Secondly, questionnaire surveys were designed and collected. Thirdly, the collected questionnaire surveys were analyzed according to different types of service spaces, and the evaluation of the service capacity of those spaces was hierarchically classified. Finally, through the dual-source data comparison and feature induction of POI data and questionnaire surveys, the service

capacity of the waterfront public space in the Changning section of the Suzhou Creek was evaluated. The results show three satisfaction indexes, including accessibility, landscape visual quality, and service functions, play a positive effect on the service capacity of waterfront public spaces. With the proposed approach, further optimization of waterfront space design based on the evaluation of the service capacity will be more accurate and closer to residents' living and spiritual needs.

2. Materials and Methods

2.1. Research Subjects

The waterfront public space surrounding the Changning section of Suzhou Creek (see Figure 1) was chosen as the primary analysis object in this work since multiple types of these public spaces, including commercial, cultural, educational, and tourist amenities, were distributed in this section. The south bank of the Changning section of Suzhou Creek comprises office buildings in industrial parks. In contrast, the north bank is mostly occupied by schools, viaduct underpasses, and urban pedestrian greenways [30]. Regarding the investigation of the service capability satisfaction, service function categories, and spatial layout characteristics of public service spaces, the following ten service stations surrounding Changning were chosen: (A) Linkong No.1 Music Park, (B) Linkong Skateboard Park, (C) Fengling Park, (D) Rock Park, (E) Tianyuan Riverfront Park, (F) Hongqiao Riverside Park, (G) DOHO Creative Park, (H) Thirty-Seven People's Evening School Station, (I) Zhongshan Park, and (J) Huazheng Service Station.

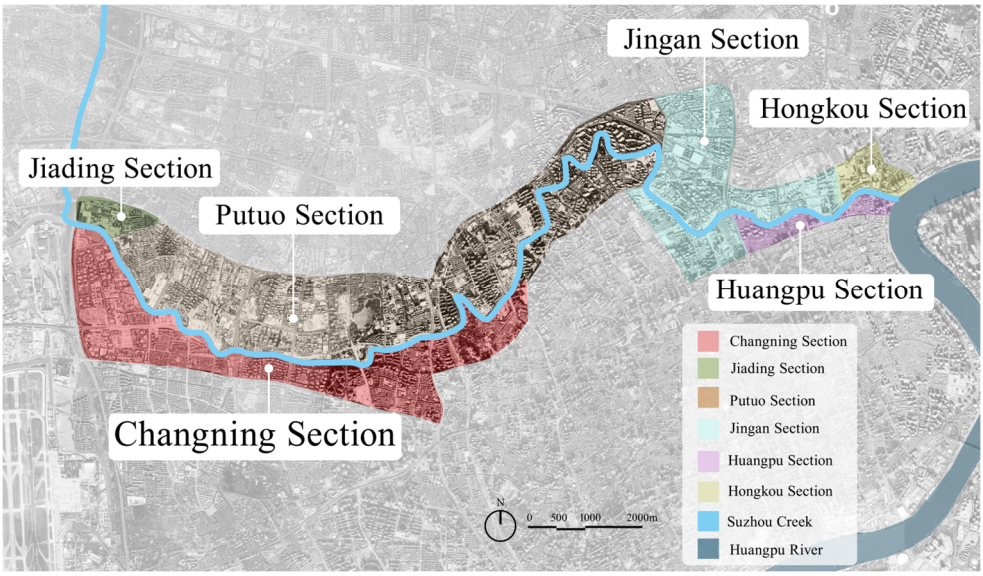

Figure 1. The location of the Changning Section in Shanghai Suzhou Creek.

2.2. POI Data Sources

a. Data collection

The POI data were collected from Baidu Map in 2022. Firstly, the web service API (Application Programming Interface) on Baidu Map was used to obtain the facility data of POI points in the Changning District of Shanghai City (see Figure 2). Secondly, the number of facilities accessible within a 15-min walking range of ten service stations in the Changning section of Suzhou Creek were counted and screened according to the requirements of facility accessibility in the "Shanghai 15-min Community Living Circle Planning Guidelines" [31]. As a new concept for urban space planning, the "15-min living circle" is the basic structure of community life within walking distance of "clothing, food, housing, transportation, culture, sports, education, and health". This region typically serves a population of 50,000 to 100,000 people and is accessible by foot over 800 to 1000 m [32]. Within this region, public services that are required daily by citizens should be

provided as comprehensively as possible. A service radius of 1 km and 15 min for public service facilities was adopted to compare the distribution of those facilities based on this coverage region.

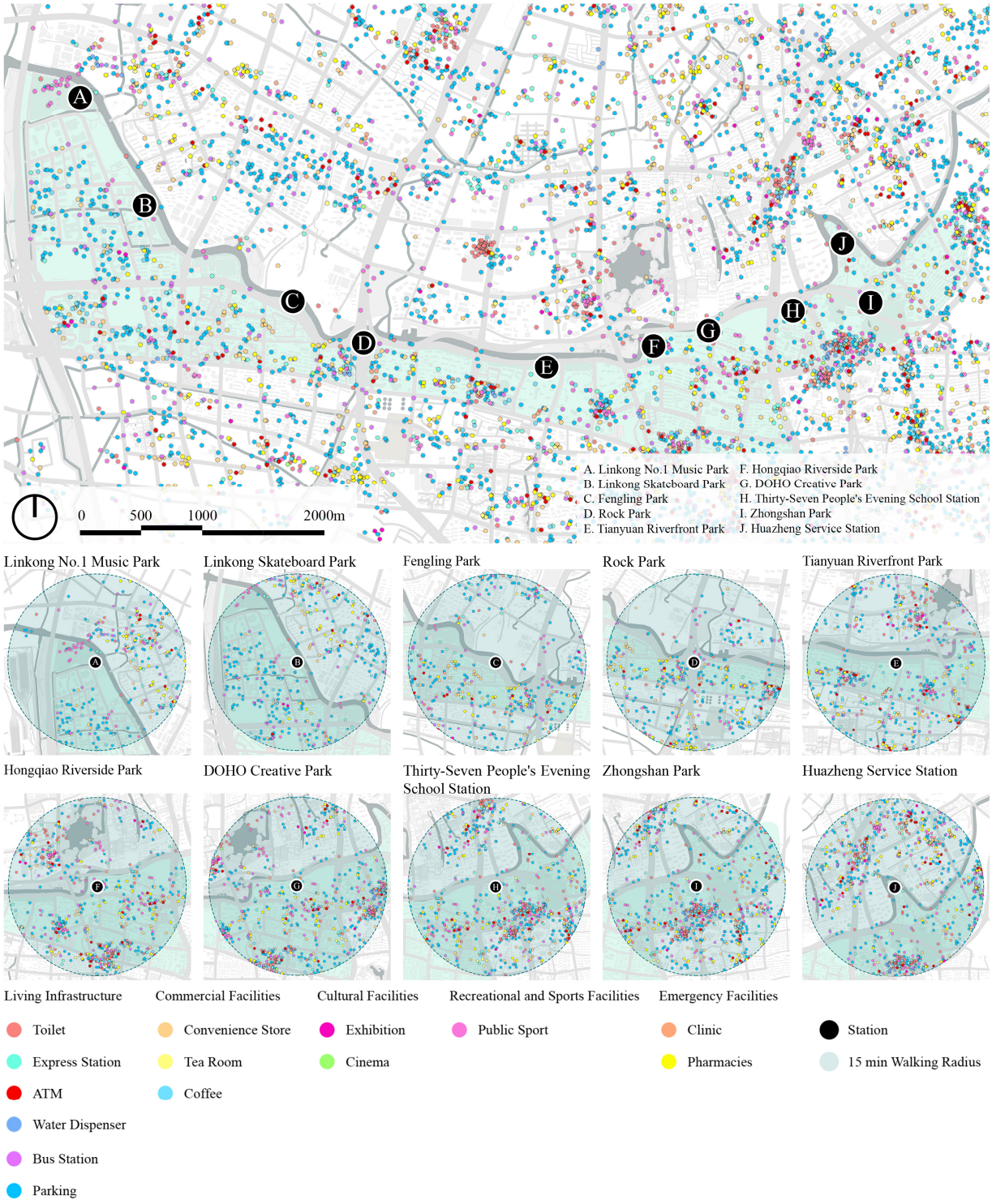

Figure 2. POI data of ten waterfront public service stations.

POI data were chosen per the Residential Building Code (GB50368-2005) [33], considering which public service facilities are most directly connected to the waterfront recreation area. The public service facilities were divided into five categories: living facilities, commerce, education and culture, sports and recreation, and emergency facilities. Specific

facilities included public restrooms, post offices, self-service ATMs, drinking fountains, bus stops, parking lots, convenience shops, tea rooms, cafes, exhibition halls, movie theaters, public sports facilities, clinics, and pharmacies.

b. Data validation

The data validation was performed using a statistical analysis method. The normal distribution verification of the original POI data was first carried out. In statistical analysis, a normal or approximate normal distribution of the data is an effective method to verify its validity [34]. In this work, the original latitude and longitude data of around 50,000 POI facility points with five categories were verified using the Statistical Package for Social Scientists (SPSS version 25.0) Descriptive Analysis. By displaying various levels of kurtosis, skewness, quantiles, and geographical location, the distribution characteristics of the data can be described in detail. As shown in Table A1, the mean longitude and the corresponding standard deviation were ~121.403 and ~0.025, respectively, showing a slight skew to the left (skewness: −0.419) and a slight negative kurtosis (kurtosis: −0.557). The value of longitude ranged from ~121.327 to ~121.451. Meanwhile, the mean latitude and the corresponding standard deviation were ~31.232 and ~0.023, respectively (skewness: 0.344, kurtosis: −0.54). Since skewness and kurtosis values were close to 0, the collected data could be considered a normal distribution.

Meanwhile, quantile analysis was utilized to validate data outliers. Quantile analysis is a statistical method to detect outliers and data robustness of data samples [35]. The analysis results (see Table A1) showed that in terms of the longitude values, the 10th, 50th, and 90th percentiles were ~121.366, ~121.406, and ~121.434, respectively (~90% of the longitude values were below or equal to ~121.434). Similarly, for the latitude values, the 10th, 50th, and 90th percentiles were ~31.204, ~31.233, and ~31.264, respectively (~90% of the latitude values were below or equal to ~31.264). The distribution of quantiles in the 10th, 50th, and 90th intervals remained almost the same. Therefore, it can be concluded that the sample values were not affected by the outliers in the data, and the whole data exhibited high robustness. In addition, the accuracy of the data from a geographical perspective was verified. Verifying the validity of the geographical locations of the data helps to enhance the reliability of the data. According to the latitude and longitude range of the Changning district in Shanghai [36], all collected data were within this range.

2.3. Questionnaire Survey

a. Questionnaire design

The questionnaire design was based on a site analysis method, as illustrated in Table A2. The questionnaire includes ten questions about the respondent's age, gender, visit frequency, commute mode, commute duration, etc. The questionnaire survey was conducted at ten service stations along the Changning section of the Suzhou Creek. The data were collected through the distribution of questionnaires in person, as well as through cross-sectional and longitudinal analysis [37].

b. Questionnaire survey

The questionnaire surveys were conducted thrice in September 2021, June 2022, and September 2022 (see Table A3). A total of 190 questionnaires were distributed, and 145 were legitimately collected, with a recovery rate of 76%. Among the 82 men and 63 women who participated in the survey, 16 respondents were between 0 and 18 years old, 38 respondents were between 18 and 30, 22 respondents were between 30 and 60, and 69 respondents were 60 or older. Seventy-five of the respondents had a bachelor's degree or higher in education. A larger sample size could not be obtained for the study due to the COVID-19 pandemic.

2.4. Research Framework and Methodology

Figure 3 depicts the research framework for the evaluation of the service capacity of waterfront public space, which consists of the following steps: (1) Collection of POI data and questionnaire surveys, (2) Data processing, (3) Analysis of satisfaction factors on

service capacity, (4) Formation of optimization strategy for the waterfront public space. With the combination of POI data and questionnaire surveys for data collection and analysis [38], this work conducted a cross-sectional sample study on the spatial layout, traffic accessibility, usage feedback, service type, satisfaction, and green space system of ten public service stations.

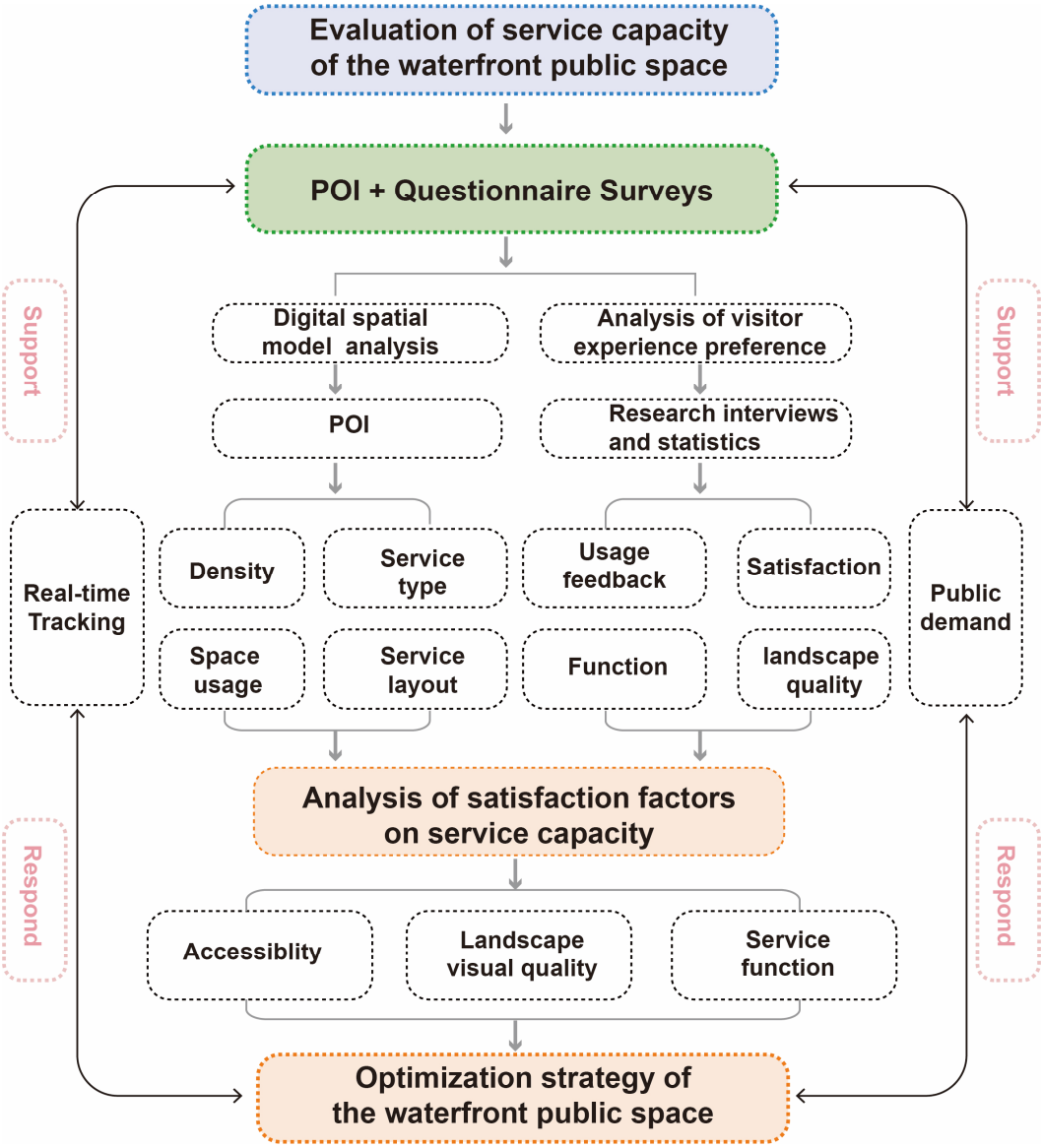

Figure 3. Research framework.

3. Results and Discussion

3.1. Statistical Results of Data

a. Accessibility of waterfront public space through POI data analysis

Based on the POI data of ten public service spaces in the Changning section of the Suzhou Creek, the information on the spatial geographic distribution density of different public service facilities was obtained as follows (See Table A3).

Living service facilities: The station with the highest distribution rate (18%) was Station J. The other stations with distribution rates above 10% were Stations I (12%), F (12%), G (12%), and E (10%). The stations with distribution rates below 10% were Stations A, B, C, D, and H.

Commercial service facilities: The station with the highest distribution rate (20%) was Station J. The other stations with distribution rates above 10% were Stations H (14%), G (12%), and I (12%). The stations with distribution rates below 10% were Stations A, B, C, D, E, and F.

Sports and leisure facilities: The station with the highest distribution rate (17%) was Station F. The other stations with distribution rates above 10% were Stations I (15%), J (12%), and G (12%). The stations with distribution rates below 10% were Stations A, B, C, D, E, and H.

Cultural and educational facilities: The station with the highest distribution rate (20%) was Station J. The other stations with distribution rates above 10% were Stations F (17%), I (15%), H (15%), E (11%), and G (11%). The stations with distribution rates below 10% were Stations B, C, and D. There were almost no cultural and sports facilities in Station A.

Emergency service facilities: The stations with distribution rates above 10% were Station F (14%), J (13%), D (12%), I (12%), H (11%), E (11%), and G (11%). The stations with distribution rates below 10% were Stations A, B, and C.

Therefore, it can be concluded that Station J was the service station with the most densely distributed public service facilities in the Changning section of the Suzhou Creek. Station A exhibited the most unbalanced distribution of public service facilities.

Meanwhile, through the classification of those facilities within a 15-min living circle, the statistical ratios of living service facilities, commercial service facilities, sports and leisure facilities, emergency service facilities, and cultural and educational facilities were 75%, 14%, 7%, 3%, and 1%, respectively. Therefore, the ratio of living service facilities was almost three-quarters of the public service facilities distributed in the Changning section of the Suzhou Creek.

b. Visitor feedback on the waterfront service space through questionnaire surveys

Table A3 displays the visitors' preference for ten public service stations from the questionnaire surveys, which consists of approximately 32% leisure, 28% physical exercise, 19% gathering activities, 15% tourism, and 6% passing. Table A4 displays the number of living service facilities, commercial facilities, educational and cultural facilities, sports and leisure facilities, and emergency service stations, as well as the satisfaction levels of the five categories of public service spaces. According to the statistical data, Station J was the most comprehensive living service facility and commercial service station; Stations J and F were the most comprehensive educational and cultural service stations; Station F was the most comprehensive sports and leisure service station; and Station F was the most comprehensive emergency service station.

3.2. Impact of Accessibility on the Usage of Waterfront Public Space

a. Walkable waterfront public space

As shown in Figure 4, the residential neighborhood can be reached from Stations F and J in under 15 min. Based on the questionnaire survey (See Table A2), most station visitors were local residents, most of whom were older individuals who preferred to walk to the stations. Most visitors were estimated to arrive at the public service station in under 30 min, and transportation is one of the most influential factors in determining station ratings. The results of the questionnaire survey (145 respondents) revealed that the preferable modes of transportation for visitors to the service stations (in order of preference) were walking (55 people, 37.9%), cycling (41 people, 28.3%), public transit via subway or bus (31 people, 21.4%), and driving (18 people, 12.4%). Therefore, the distance between transportation facilities significantly impacted the utilization rates of service stations. Moreover, elderly and middle-aged people had longer acceptable arrival times than younger people, as they typically enjoyed more leisure time.

b. Waterfront public space close to traffic stations

Figure 5 presents the POI data surrounding the Stations C, D, E, and F. As shown in Figure 5, the walking radius of five, ten, and fifteen minutes were used to separate those stations

from the nearby traffic hubs. Among those stations, Station F exhibited an optimum distribution of parking spaces, subway platforms, and bus stops in three walking radius. Compared with Station F, the corresponding distributions of Stations C and D were not balanced, significantly reducing their utilization rates. Figure 6 shows that the service area in Station C was closed according to the on-site survey due to its underutilized conditions. Therefore, the public spaces close to transportation centers such as buses, subways, and parking stations usually have a high utilization rate due to the convenience of walkable accessibility.

Figure 4. (**a**) Station F (Hongqiao Riverside Park) and (**b**) Station J (Huazheng Service Station) in the 15 min walking radius with the residential area.

c. Waterfront public space near urban green space

According to the geographic locations of ten waterfront public service stations, Stations A, B, C, and E were all located in the urban green park. Stations D and F were near the small pocket garden (see Figure 7). In contrast, Stations G and H were not located in the urban green park except for two 1 km green corridors with rudimentary green facilities. However, the satisfaction survey results of those service stations (see Table 1) indicated that the top three stations with high satisfaction levels were Stations J, F, and I. Stations A, B, and C exhibited weak satisfaction. Therefore, visitor satisfaction was not affected by the surrounding greenery. And what's more, there was no direct correlation between the location of the urban green space and the utilization rate of the service station [39,40], which was hardly determined by the POI data analysis.

3.3. Effect of Landscape Visual Quality on Experience of Public Service Space

Figure 8 presents the purpose of visits for different age groups. The age group below 18 and the age group of 18–30 exhibited the highest demand for physical exercise service space and leisure service space, respectively. The age group of 30–60 and above 60 exhibited the highest demand for gathering activity and leisure service space, respectively. Figure 9 shows the space requirements for different age groups. For the age group below 18, the top-three space requirements were landscape visual quality (33.3%), cycling/running (26.7%), and public service facilities (20.0%). For the age group of 18–30, the top-three space requirements were landscape visual quality (30.1%), cycling/running (25.0%), and cultural space (19.4%). For the age group of 30–60, the top-three space requirements were public service facilities (31.8%), landscape visual quality (22.7%), cultural space, and cycling/running (18.2%). For the age group above 60, the top-three space requirements were landscape visual quality (29.2%), public service facilities (25.0%), and cultural space (20.8%). Therefore, it can be concluded that according to the landscape visual quality is

the primary concern of visitors for selecting public service stations. With the questionnaire survey, visiting purposes of the visitor and visitor experience can be efficiently obtained.

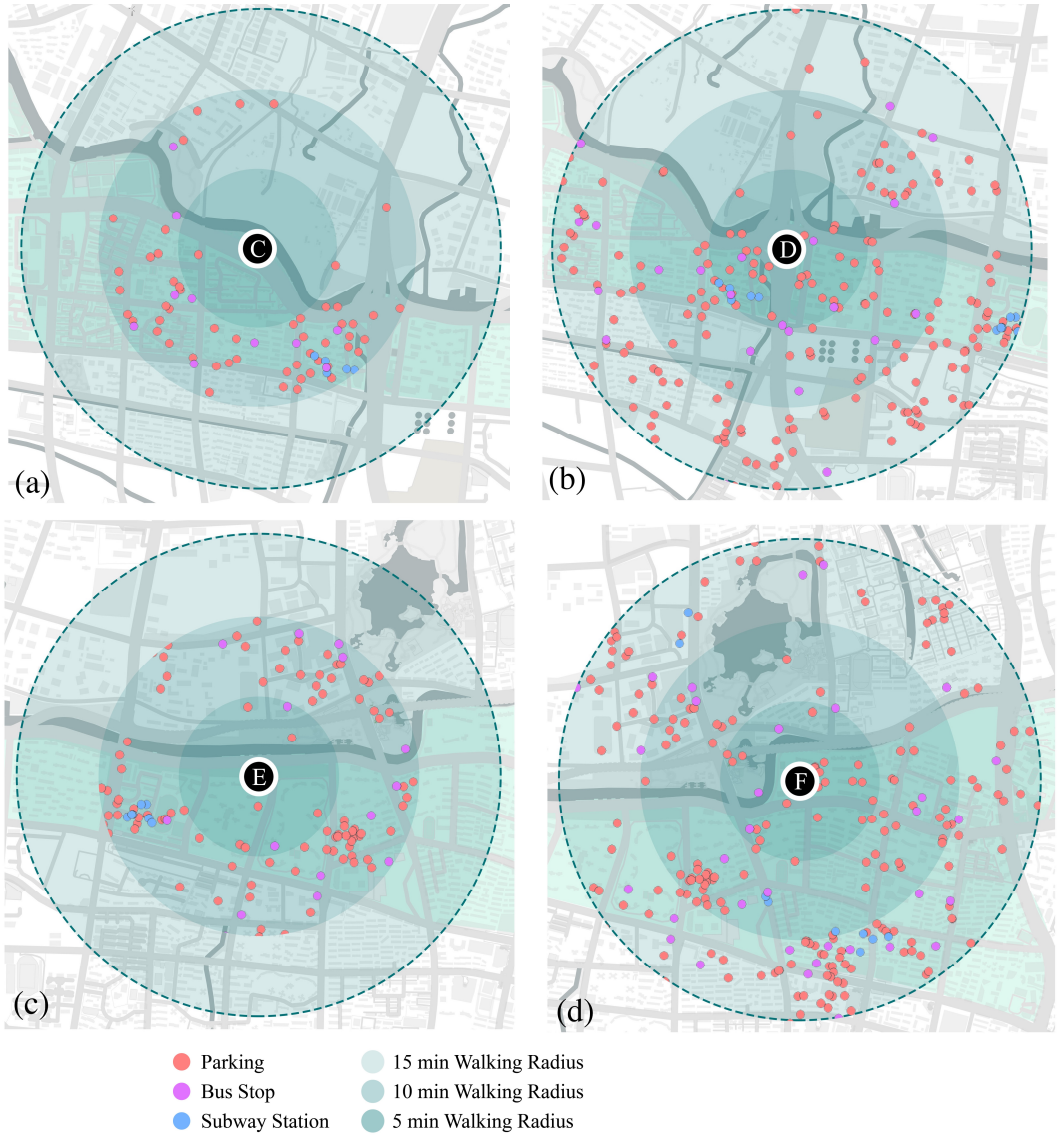

Figure 5. (**a**) Station C (Fengling Park), (**b**) Station D (Rock Park), (**c**) Station E (Tianyuan Riverfront Park), and (**d**) Station F (Hongqiao Riverside Park) in surrounding transport stops in 5 min, 10 min, 15 min's radiation.

Figure 6. Site photo of Station C (Fengling Park).

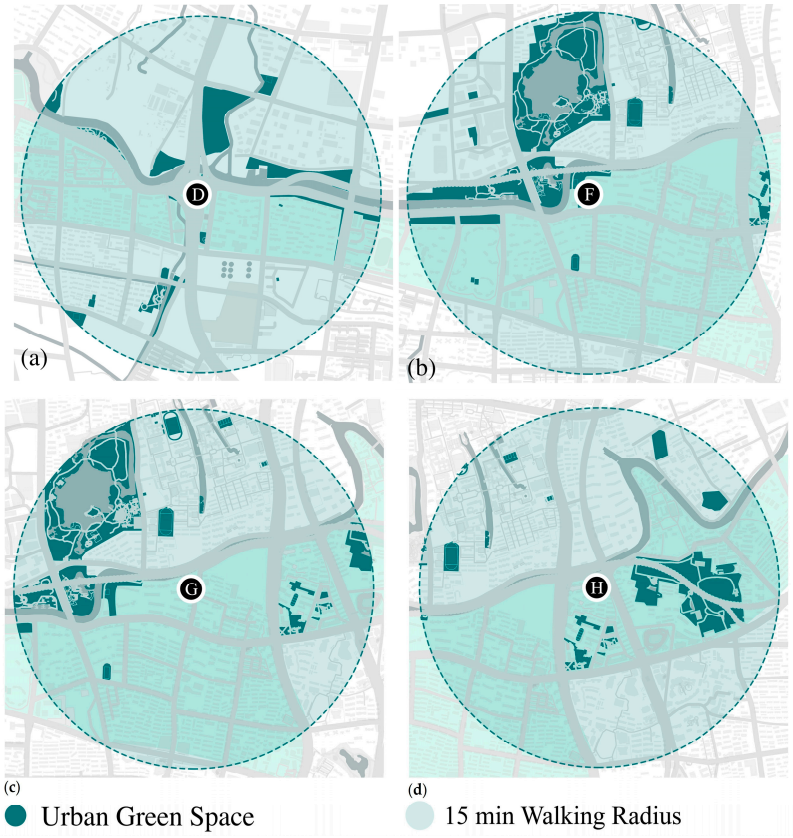

Figure 7. (**a**) Station D (Rock Park) and (**b**) Station F (Hongqiao Riverside Park) in the 15 min walking radius with the urban green space. (**c**) Station G (Doho Creative Park) and (**d**) Station H (Thirty-Seven People's Evening School Station) in the 15 min walking radius with the urban green space.

Table 1. Satisfaction survey results of waterfront public service spaces.

Station	Residential Area	Living Facilities	Commercial Facilities	Cultural Facilities	Recreational and Sports Facilities	Emergency Facilities	Overall Ranking
A	Low	Low	Low	Low	Relatively Low	Low	10
B	Low	Medium	Low	Relatively Low	Low	Low	8
C	Low	Relatively Low	Low	Low	Medium	Low	9
D	Medium	Relatively Low	Low	Medium	Relatively Low	Relatively High	5
E	Medium	Medium	Medium	Low	Medium	Low	7
F	High	Relatively High	High	Relatively High	Relatively High	High	2
G	Relatively Low	Relatively Low	Medium	Relatively Low	Medium	Low	6
H	Medium	High	Low	Relatively Low	Medium	Medium	4
I	High	Relatively High	Medium	Medium	Relatively High	High	3
J	High	High	High	Relatively High	High	Relatively High	1

Satisfaction levels (in the order of rank): High, Relatively High, Medium, Relatively Low, Low.

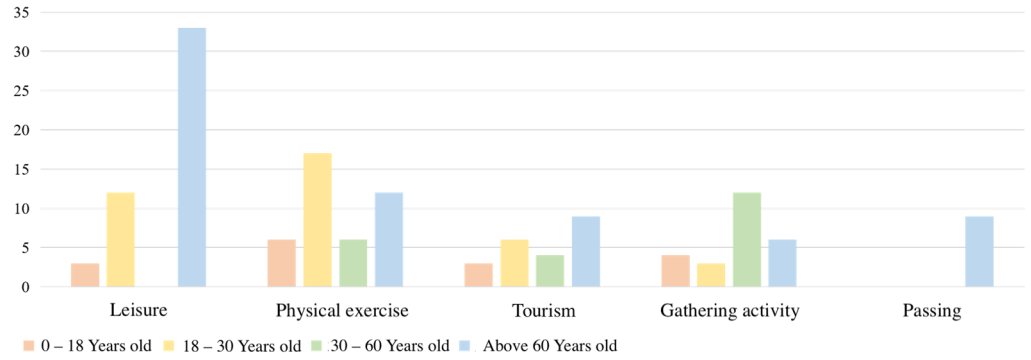

Figure 8. Purpose of visits for different age groups.

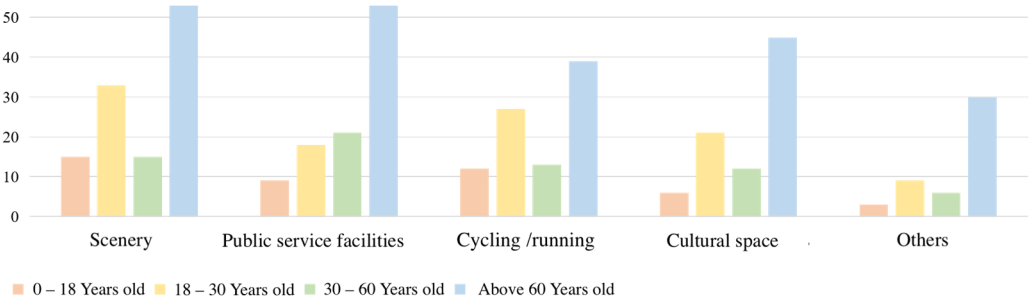

Figure 9. Space requirements for different age groups.

3.4. Service Function

a. Function of recreational activities

Figure 10 presents a chart of the visitor's purpose for all public service stations. The top-three purposes of visits were leisure activities (28%), physical exercise (23%), and tourism (20%). Figure 11 shows the survey results of space requirements. The main space requirements (in order of rank) were scenery, public service facilities, cycling/running, and cultural space. The preference ranking of recreational activities was primarily based on the functions of running, walking, dancing, playing basketball, and skateboarding (see Table A3). The preferred activities of young and middle-aged visitors were basketball, dancing, performing musical instruments, and skateboarding. In contrast, the most popular activities among older people and children were running, walking, and leisurely strolling.

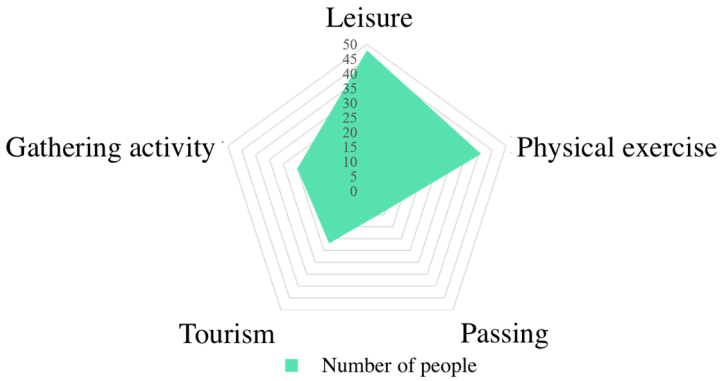

Figure 10. Chart of the purpose of visits.

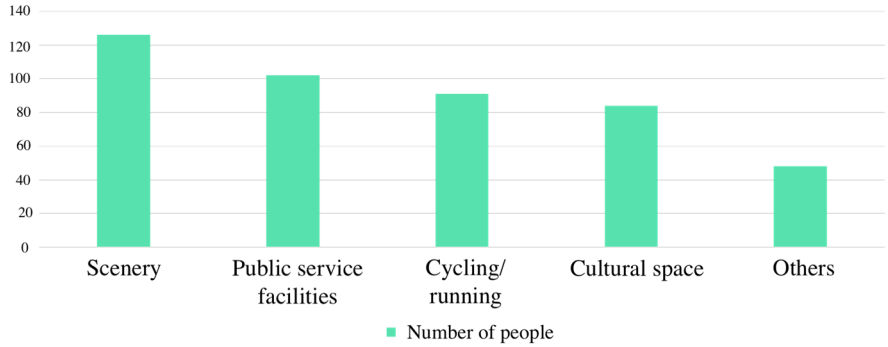

Figure 11. Diagram of space requirements.

b. Functions of co-shared space

As the utilization rate of the public service space increases and the types of visitors become more diverse, the demand for public service space transfers from a simple function of public facilities to a co-shared space for activities. Compared to other service spaces, shared service spaces with the capability of autonomously organizing activities can attract more returning visitors and have a greater impact on the dissemination of the service space. As shown in Table A4 (type of annual event), the service stations of the Changning section (Stations F, I, and J) including the reading festival, neighborhood committee election, media conference, and theme concert, as well as their corresponding service spaces, were utilized more frequently. Moreover, the location of these service stations in residential and office areas reflected the higher attraction of co-shared space functions to the daily participation activities of adjacent residents [41].

c. Relationship of service functions and urban resources

Based on the functional business distribution of the POI points of public service facilities within one kilometer of the depicted public service space, we discovered that four aspects of urban resource matching could impact the utilization rate of public service space.

Commercial resources. According to the enlarged map of service functions in Figure 12, Stations D and F were in the dense commercial distribution area. Combined with the questionnaire surveys, the usage and visitor feedback of the public service space was relatively good. The overall space environment could be managed and developed autonomously and continuously. By adding healthy activity facilities such as walking paths, running tracks, and bicycle paths, the connection between public spaces and the surrounding commercial resources such as sports brands, restaurants, light food cafeterias, and offices could be enhanced [42].

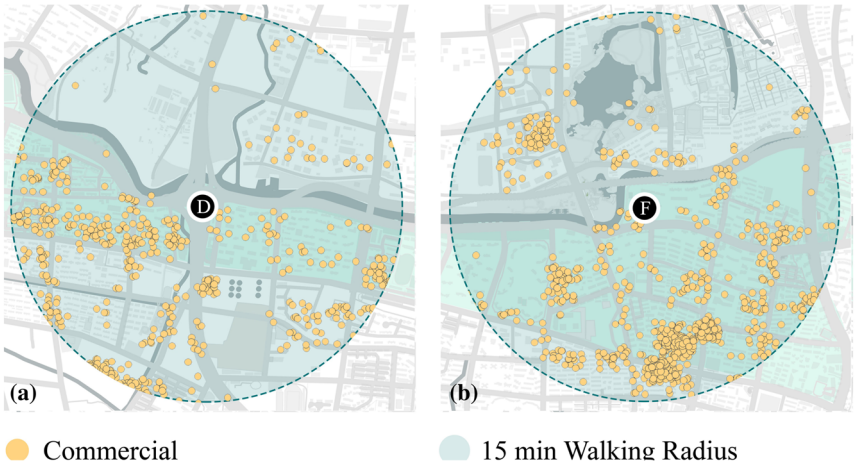

Figure 12. (**a**) Station D (Rock Park) and (**b**) Station F (Hongqiao Riverside Park) in the 15 min walking radius within the nearby commercial area.

Tourism resources. According to the enlarged map of the service function business in Figure 13, Stations F and I were in or near a green space park. Combined with the questionnaire survey, both the public service stations had good landscape conditions. However, the ornamental value of those stations did not meet the visual quality and leisure requirements, which needed to be improved to attract urban visitors [43]. Therefore, the improvement of the ornamental value of urban green space and the natural landscape of the waterfront could be considered for the development of tourism for sightseeing and leisure activities.

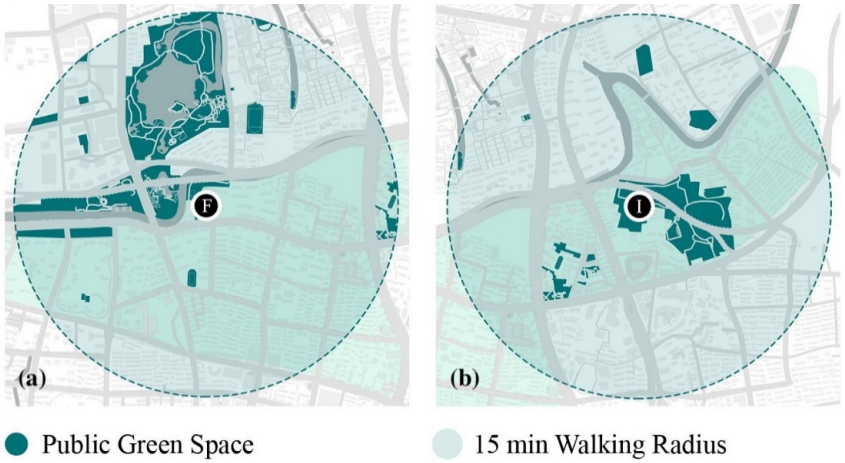

Figure 13. (**a**) Station F (Hongqiao Riverside Park) and (**b**) Station I (Zhongshan Park) in the 15 min walking radius with the public green space.

Cultural resources. By reorganizing public service stations with sports and recreational activities can improve the connectivity of urban cultural resources [44]. For instance, a shared basketball stadium was built near Station D, waterfront running paths were built near Station E, and basketball sports facilities, swimming pools, and bicycle clubs were located near Station F. Those three service stations mentioned above, as well as the nearby leisure and sports centers, are all accessible on foot in less than 1 km. Moreover, according to the satisfaction survey of ten service stations, Station F was the second highest rated. Therefore, combining the organized layout of public service space and the adjacent cultural resources can increase visitors' service satisfaction.

Based on the analysis of the purpose of the visitors' visit and their space requirements mentioned above, the rational design of the co-sharing space and matching it with related to adjacent municipal resources will become important factors for planning and improving the service capacity of the urban public space.

4. Conclusions

In conclusion, we proposed a hybrid approach for the analysis and evaluation of the service capacity of the public space in the Changning Section of Suzhou Creek in Shanghai using a combination of POI data analysis and questionnaire surveys. With the proposed approach, the service capacity evaluation for ten public service stations provides a ranking from best to worst and honest feedback on each service space's drawbacks. This approach provides a rationale for the intelligent management and dynamic assessment of future public service space, which will be beneficial for further improvement of urban vitality.

The main results were as follows.

a. Utilization rates of public service spaces are greatly impacted by accessibility.

Accessibility significantly increases the capacity index of public service stations. Regarding accessibility, the service space that can be reached on foot provides the most satisfaction, followed by the space that can be reached by bicycle. People are satisfied with public service stations if they enjoy a pleasant walking experience, such as locating service

space within a 15 min walking circle and walking along a shady, green path [45]. Regarding the utilization rate, public service areas are suggested to allocate walking experiences to transportation hubs, green spaces, and sub-service stations.

b. Landscape visual quality is an important indicator of the visitor experience.

Statistic data from questionnaire surveys indicate that when evaluating the quality of the landscape, visitors place a higher value on the neighboring public service space's view than on the condition of the greenery. A single analysis of POI data cannot entirely reveal the true demand for service quality, which mainly demonstrates the density and proportion of greenery in adjacent areas. By integrating multiple data sources, the proposed methodology proves how closely the service quality is related to the adjacent landscape quality [46,47]. Enhancing the narrative quality of the landscape design of public service spaces is crucial for improving the experience of waterfront sightseeing.

c. Sharing service features and matching urban resources facilitate the improvement of public space utilization.

Public service spaces that provide shared entertainment, exercise, and small gatherings tend to have higher utilization rates. Meanwhile, the interconnected functions of adjacent commercial, recreational, tourist, cultural, and residential resources can promote frequent and sustainable use of public service space.

With the proposed method, the evaluation accuracy of public space's design and service capacity can be increased. Firstly, evaluations of service availability are more precise. Although only statistical density can be derived from POI data, the introduction of questionnaire surveys can provide a detailed description of the service's characteristics and the impact score that this density creates. Secondly, POI is a real-time distribution of facilities based on big data capture, but it cannot fully represent the actual use of public service space. Combining questionnaire surveys with POI data makes it possible to test the real-life usage of public service space, creating a more genuine service capability evaluation content. Thirdly, it is possible to determine the needs of different age groups. In terms of specific service functions, the combined data can also be used to comprehend the preferences of the service community concerning various characteristics [48]. In the future, a multi-source data analysis will be performed by combining the POI data with questionnaires and other site observation techniques [49,50] to investigate the rationality of urban public service space layout and develop the urban regeneration strategy. This research methodology can be used to evaluate service satisfaction in waterfront public service spaces and other urban public service facilities.

The current research based on the hybrid approach is still in its infancy, with several limitations. First, the evaluation of visitor satisfaction needs to be further improved. Due to their varying levels of education, the interviewees have various requirements for space quality, which require more survey samples and more precise determination. For instance, the number of interviews should be continuously increased, while respondents' income and educational levels should be precisely defined for data analysis. Second, the questionnaire design should enhance correlation verification to improve the questionnaire survey's reliability and validity. To improve the quality of questionnaire surveys, incorporating expert evaluation, pretesting questionnaire samples, and increasing the quantitative level of experiences should be considered in the future. Thirdly, the accuracy of service facilities should be validated in real-time, even though the POI data obtained from the Internet map open platform has been under significant filtering. Some facilities have been closed due to renovations or business adjustments, and the accuracy of service facilities should be verified in real-time.

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Appendix A

Table A1. Descriptive statistics of variables.

		Longitude	Latitude
Name		51,379 0	51,379 0
Mean		121.403	31.232
Std. Error of Mean		0.00011	0.00010
Median		121.406	31.233
Mode		121.416	31.213
Std. Deviation		0.025	0.023
Variance		0.001	0.001
Skewness		−0.419	0.344
Std. Error of Skewness		0.011	0.011
Kurtosis		−0.557	−0.540
Std. Error of Kurtosis		0.022	0.022
Range		0.124	0.118
Minimum		121.327	31.181
Maximum		121.450	31.300
Sum		6,237,579.91	1,604,670.30
Percentiles	10	121.366	31.204
	20	121.382	31.210
	25	121.386	31.213
	30	121.390	31.216
	40	121.400	31.220
	50	121.406	31.233
	60	121.413	31.238
	70	121.420	31.244
	75	121.423	31.247
	80	121.426	31.252
	90	121.434	31.264

Table A2. English translation version of Questionaries Survey.

Question Number	Question
Question 1	What is your age? A: 0–18 years old B:18–30 years old C: 30–60 years old D: 60 years old and above
Question 2	What is your occupation?
Question 3	Are you a regular visitor to this area (Station)? A: Everyday B: Once a week C: Two or three times a week D: Occasionally
Question 4	When do you usually visit this area (Station)? A: Weekdays B: Weekends C: Everyday D: Morning E: Noon F: Afternoon G: Evening
Question 5	How do you get here? A: Driving B: Cycling C: Public transport (subway, bus) D: Walking
Question 6	How long did it take you to get here? A:<5 min B: 5–15 min C:15–30 min D:>30 min
Question 7	Why did you come here? A: Leisure B: Physical exercise C: Passing D: Tourism E: Gathering activity
Question 8	Are you satisfied with the following public service facilities? Rest facilities A: Satisfactory B: Unsatisfactory C: Fair General child-friendly facilities A: Satisfactory B: Unsatisfactory C: Fair Street facilities A: Satisfactory B: Unsatisfactory C: Fair Service Facilities A: Satisfactory B: Unsatisfactory C: Fair Lighting A: Satisfactory B: Unsatisfactory C: Fair Information and signage facilities A: Satisfactory B: Unsatisfactory C: Fair Other:

Table A2. *Cont.*

Question Number	Question
Question 9	Which of the following types of public service space are you most interested in? A: Food and drinks B: Co-share working space C: Culture and history D: Sport E: others
Question 10	Which aspects contribute to your enjoyment of leisure activities in Shanghai? A: Scenery B: Service facilities (Food and drinks, baby care room, etc.) C: Cycling paths, running track D: Reading rooms E: Other

Table A3. Visitor preference in the survey questionnaire.

Age	Type	Occupation	Gender		Purpose	Station	Number
0–18 Years Old							16
	Tourist	Primary school students	Female	▲	Tourism	F	
	Visitor	Primary school students	Male	★	Physical exercise	I	
	Community Resident	Junior high school student	Female	■	Gatherings	F	
	Community Resident	High school students	Male	★	Play basketball	D	
	Community Resident	High school students	Male	•	Leisure	F	
18–30 Years Old							38
	Visitor	High school student	Female	▲	Tourism	J	
	Community Resident	College student	Male	★	Physical exercise	B	
	Tourist	College student	Male	•	Leisure	J	
	Tourist	College student	Female	★	Physical exercise	J	
	Tourist	Corporate staff	Male	•	Leisure	D	
	Community Resident	Corporate staff	Female	★	Come with child	E	
	Tourist	Corporate staff	Male	★	Skateboarding	B	
	Tourist	Corporate staff	Male	▲	Tourism	F	
	Community Resident	Officer	Female	•	Leisure	C	
	Community Resident	Officer	Female	•	Leisure	C	
	Community Resident	Officer	Female	■	Come with child	D	
	Tourist	Officer	Male	★	Physical exercise	E	
30–60 Years Old							22
	Tourist	Artist	Male	■	Take a photo	E	
	Visitor	Corporate staff	Male	▲	Tourism	B	
	Community Resident	Corporate staff	Female	■	Come with child	J	
	Tourist	Officer	Female	★	Play basketball	D	
	Community Resident	Officer	Male	■	Saxophone playing	F	
	Tourist	Retiree	Male	★	Physical exercise	G	
	Community Resident	Retiree	Female	■	Plaza dancing	I	
Above 60 Years Old							69
	Community Resident	Retiree	Male	■	Dancing Practice	I	
	Community Resident	Retiree	Female	■	Gatherings	I	
	Community Resident	Retiree	Male	•	Leisure	I	
	Visitor	Retiree	Female	▲	Tourism	I	
	Community Resident	Retiree	Male	•	Leisure	I	
	Visitor	Retiree	Female	▲	Tourism	J	
	Community Resident	Retiree	Male	•	Leisure	J	
	Community Resident	Retiree	Female	◆	Passing	J	
	Tourist	Retiree	Male	•	Leisure	H	
	Community Resident	Retiree	Female	•	Leisure	F	
	Community Resident	Retiree	Male	★	Physical exercise	F	
	Community Resident	Retiree	Male	•	Leisure	F	
	Tourist	Retiree	Female	▲	Tourism	F	
	Tourist	Retiree	Male	★	Fishing	E	
	Community Resident	Retiree	Female	•	Leisure	E	
	Community Resident	Retiree	Male	•	Leisure	E	
	Tourist	Retiree	Female	◆	Passing	D	
	Community Resident	Retiree	Male	★	Physical exercise	C	
	Community Resident	Retiree	Female	•	Leisure	C	
	Tourist	Retiree	Male	•	Leisure	C	
	Community Resident	Retiree	Male	★	Fishing	B	
	Community Resident	Retiree	Male	◆	Passing	A	

• Leisure, ★ Physical exercise, ▲ Tourism, ■ Gathering activity, ◆ Passing.

Table A4. POI data of public service facilities from Station A to Station J.

Station			A	B	C	D	E	F	G	H	I	J
Facilities	Living Facilities	Toilet	8	6	10	9	69	69	72	65	91	103
		Express Station	16	17	12	12	13	16	15	20	24	26
		ATM	7	6	6	5	14	19	13	14	16	22
		Water Dispenser	6	0	5	5	8	9	8	11	15	11
		Bus Station	18	25	18	19	20	30	21	18	16	20
		Parking	115	155	101	126	152	164	158	167	166	217
		Residence	87	124	92	111	137	209	213	201	197	367
	Commercial Facilities	Convenience Store	34	24	32	41	34	49	52	48	57	77
		Tea Room	2	1	2	1	4	5	3	6	6	9
		Cafe	9	17	9	15	34	38	42	53	35	75
	Cultural Facilities	Exhibition	0	2	0	1	4	5	3	4	3	5
		Cinema	0	0	1	1	1	3	2	3	4	4
	Recreational and Sports Facilities	Sport	32	9	17	25	35	62	45	53	56	45
	Emergency Facilities	Clinic	0	1	6	11	10	12	5	4	4	5
		Pharmacies	16	14	4	18	17	22	21	23	25	27

Table A5. Annual event activities hosted in the ten public service stations from 2021–2022.

Station	Time	Events	Organizers	Participants
I	Regularly held	Stage Performance	Zhongshan Park Staff	Residents
I	Regularly held	Running Group	Residents	Residents
I	Regularly held	Dancing Group	Residents	Residents
J	All year round	Visit the campus	East China University of Political Science and Law	Residents
J	Chinese New Year	Folklore events	Changning Cultural Arts Centre	Residents
H	All year round	Party and group activities	Volunteer Workshop for Party Members	Residents
F	Regularly held	Dancing Group	Residents	Residents
F	Regularly held	Basketball game	Residents	Residents
F	May	Women's Half Marathon	Shanghai Government	Competitors
C	All year round	Party and group activities	Volunteer Workshop for Party Members	Residents
E	May	Women's Half Marathon	Shanghai Government	Competitors
D	Regularly held	Basketball game	Rock Park Staff	Residents
D	Regularly held	Football Tournament	Rock Park Staff	Residents
B	Regularly held	Skateboarding competition	Residents	Residents

References

1. Mandeli, K. Public space and the challenge of urban transformation in cities of emerging economies: Jeddah case study. *Cities* **2019**, *95*, 102409. [CrossRef]
2. Shi, T.M.; Piao, Y.J.; Shi, Y. Research on the spatial pattern of urban living service facilities in Shenyang based on POI data. *J. Shenyang Jianzhu Univ. (Soc. Sci.)* **2021**, *23*, 217–224. (In Chinese)
3. Wang, J.; Wang, X.S.; Zhao, S.; Qin, L.; Lu, X.y. Research on Evaluation of Spatial Vitality of Waterfront Spaces in Chongqing Based on SD Method. *Chongqing Archit.* **2019**, *18*, 28–31. (In Chinese)
4. Qi, R.H.; Yang, H.; Wang, S.l.; Xie, Q.Y.; Wang, Y.J. Study on Evaluation and Planning of Urban Parks Based on Baidu POI Data. *Chin. Landsc. Archit.* **2018**, *34*, 32–37. (In Chinese)
5. Xue, B.; Zhao, B.Y.; Xiao, X.; Li, J.Z.; Xie, X.; Ren, W.X. A POI Data-based study on urban functional areas of the resources-based city: A case study of Benxi, Liaoning. *Human Geogr.* **2020**, *35*, 81–90. (In Chinese)
6. Wang, W.Q.; Ma, X.J. Vitality Assessment of Waterfront Public Space Based on Multi-Source Data: A Case Study of the Huangpu River Waterfront. *Urban Plan. Forum* **2020**, *255*, 48–56. (In Chinese)
7. Li, J.Z.; Peng, T.; Long, H.Z. Research on the Location Selection Model of Emergency Service Facilities Based on Multi-source Data. *Build. Sci.* **2021**, *37*, 62–70. (In Chinese)
8. Huang, J.X.; Obracht-Prondzynska, H.; Kamrowska-Zaluska, D.; Sun, Y.M. The image of the City on social media: A comparative study using "Big Data" and "Small Data" methods in the Tri-City Region in Poland. *Landsc. Urban Plan.* **2021**, *206*, 103977. [CrossRef]
9. Liu, R.X. Research on Waterfront Public Space Evaluation Based on SD-IPA Method from the Perspective of Daily Life: A Case of the Living Section of Suzhou Creek in Shanghai. *Urban. Archit.* **2022**, *19*, 29–33. (In Chinese)

10. Liu, S.; Lai, S.Q. Influence factors of urban pubic space vitality based on multi-source data: A case study of Huangpu River waterfront area of Shanghai. *Landsc. Archit.* **2021**, *28*, 75–81. (In Chinese)
11. Wang, T.; Li, Y.; Li, H.; Chen, S.; Li, H.; Zhang, Y. Research on the Vitality Evaluation of Parks and Squares in Medium-Sized Chinese Cities from the Perspective of Urban Functional Areas. *Int. J. Environ. Res. Public Health* **2022**, *19*, 15238. [CrossRef] [PubMed]
12. Liu, H.; Gou, P.; Xiong, J. Vital triangle: A new concept to evaluate urban vitality. *Comput. Environ. Urban Syst.* **2022**, *98*, 101886. [CrossRef]
13. Cai, L.H. Study on the types and quantity distribution of park service building facilities in Beijing based on POI data. *J. Beijing For. Univ.* **2022**, *44*, 124–137. (In Chinese)
14. Liu, S.; Lai, S.-Q.; Liu, C.; Jiang, L. What influenced the vitality of the waterfront open space? A case study of Huangpu River in Shanghai, China. *Cities* **2021**, *114*, 103197. [CrossRef]
15. Boland, P.; Bronte, J.; Muir, J. On the waterfront: Neoliberal urbanism and the politics of public benefit. *Cities* **2017**, *61*, 117–127. [CrossRef]
16. Zhou, N. Research on urban spatial structure based on the dual constraints of geographic environment and POI big data. *J. King Saud Univ.-Sci.* **2022**, *34*, 101887. [CrossRef]
17. Yue, Y.; Zhuang, Y.; Yeh, A.G.-O.; Xie, J.-Y.; Ma, C.-L.; Li, Q.-Q. Measurements of POI-based mixed use and their relationships with neighbourhood vibrancy. *Int. J. Geogr. Inf. Sci.* **2017**, *31*, 658–675. [CrossRef]
18. Dai, Q. Study on facilities setting-up in urban parks under the context of optimizing stock. *Chin. Landsc. Archit.* **2016**, *32*, 103–106. (In Chinese)
19. Xue, B.; Xiao, X.; Li, J. Identification method and empirical study of urban industrial spatial Relationship based on POI big data: A case of Shenyang City, China. *Geogr. Sustain.* **2020**, *1*, 152–162. [CrossRef]
20. Zhao, P.J.; Luo, J.; Hu, H.Y. Spatial match between residents' daily life circle and public service facilities using big data ana-lytics: A case of Beijing. *Prog. Geogr.* **2021**, *40*, 541–553. (In Chinese) [CrossRef]
21. Surya, B.; Muhibuddin, A.; Suriani, S.; Rasyidi, E.S.; Baharuddin, B.; Fitriyah, A.T.; Abubakar, H. Economic Evaluation, Use of Renewable Energy, and Sustainable Urban Development Mamminasata Metropolitan, Indonesia. *Sustainability* **2021**, *13*, 1165. [CrossRef]
22. Huang, J.; Tang, Z.; Liu, D.; He, J. Ecological response to urban development in a changing socio-economic and climate context: Policy implications for balancing regional development and habitat conservation. *Land Use Policy* **2020**, *97*, 104772. [CrossRef]
23. Wu, J.; Li, J.W.; Ma, Y. Research on Characteristics and Potential of Wuhan Lakeside Landscape Spatial Cluster based on Multi-source Data Analysis. *Landsc. Archit. Acad. J.* **2019**, *327*, 20–24. (In Chinese)
24. Hassan, H.; Sumiyoshi, D.; El-Kotory, A.; Arima, T.; Ahmed, A. Measuring people's perception towards Earth-sheltered buildings using photo-questionnaire survey. *Sustain. Cities Soc.* **2016**, *26*, 76–90. [CrossRef]
25. Hu, S.; Yan, D.; An, J.; Guo, S.; Qian, M. Investigation and analysis of Chinese residential building occupancy with large-scale questionnaire surveys. *Energy Build.* **2019**, *193*, 289–304. [CrossRef]
26. Jo, H.I.; Jeon, J.Y. Compatibility of quantitative and qualitative data-collection protocols for urban soundscape evaluation. *Sustain. Cities Soc.* **2021**, *74*, 103259. [CrossRef]
27. Weijs-Perrée, M.; Dane, G.; van den Berg, P.; van Dorst, M. A multi-level path analysis of the relationships between the momentary experience characteristics, satisfaction with urban public spaces, and momentary- and long-term subjective wellbeing. *Int. J. Environ. Res. Public Health* **2019**, *16*, 3621. [CrossRef]
28. Kuang, W.; Li, S. Factors affecting park vitality in community walking circle based on multi-source data: A case study of Haidian District in Beijing. *Urban Probl.* **2021**, *11*, 36–44. (In Chinese)
29. Li, F.Z.; Qian, L.X.; Zang, F.Q.; Li, X. Study on recreational use and influencing factors of country parks in Beijing based on Tencent ravel big data. *Landsc. Archit.* **2019**, *26*, 77–82. (In Chinese)
30. Shanghai Municipal Bureau of Planning and Nature. *Suzhou Waterfront Area Construction Plan (2018–2035)*; Shanghai Municipal Bureau of Planning and nature: Shanghai, China, 2018. (In Chinese)
31. Shanghai Municipal Administration of Planning and Land Resources. *Shanghai 15-Minute Community Life Circle Planning Research and Practice*; Shanghai People's Publishing House: Shanghai, China, 2017; ISBN 978-7-208-14384-5.
32. Shanghai Planning and Land Resources Administration. *Shanghai Planning Guidance of 15-Minute Community Life Circle*; Shanghai Planning and Land Resources Administration: Shanghai, China, 2016; p. 8.
33. *GB 50368-2005*; Residential Building Code of People Republic of China. China Building Industry Press: Beijing, China, 2006.
34. D'agostino, R.B. Tests for the normal distribution. In *Goodness-of-Fit Techniques*; Routledge: New York, NY, USA, 2017; pp. 367–420.
35. Koenker, R. *Quantile Regression*; Cambridge University Press: Cambridge, UK, 2005.
36. Changning District. Available online: https://en.wikipedia.org/wiki/Changning_District (accessed on 5 July 2023).
37. Muratovski, G. *Research for Designers: A Guide to Methods and Practice*, 1st ed.; SAGE Publications Ltd.: London, UK, 2016; ISBN 1446275140.
38. Li, H.; Wang, Q.; Deng, Z.; Shi, W.; Wang, H. Local Public Expenditure, Public Service Accessibility, and Housing Price in Shanghai, China. *Urban Aff. Rev.* **2017**, *55*, 148–184. [CrossRef]
39. Chen, Y.; Liu, X.; Gao, W.; Wang, R.Y.; Li, Y.; Tu, W. Emerging social media data on measuring urban park use. *Urban For. Urban Green.* **2018**, *31*, 130–141. [CrossRef]

40. Jian, I.Y.; Luo, J.; Chan, E.H. Spatial justice in public open space planning: Accessibility and inclusivity. *Habitat Int.* **2020**, *97*, 102122. [CrossRef]
41. Wang, Y.Q. Impact of urban public service facilities on distribution pattern of housing price. *J. Landsc. Res.* **2021**, *13*, 81–88. (In Chinese)
42. Ricci, L. Integrated Approaches to Ecosystem Services: Linking Culture, Circular Economy and Environment through the Re-Use of Open Spaces and Buildings in Europe. *Land* **2022**, *11*, 1161. [CrossRef]
43. Gordon, J.E. Geoheritage, geotourism and the cultural landscape: Enhancing the visitor experience and promoting geoconservation. *Geosciences* **2018**, *8*, 136. [CrossRef]
44. Tommarchi, E.; Bianchini, F. A heritage-inspired cultural mega-event in a stigmatized city: Hull UK City of Culture 2017. *Eur. Plan. Stud.* **2022**, *30*, 478–498. [CrossRef]
45. Zhai, Y.J.; Wu, C.Z. Quantitative distribution of urban park settings and facilities based on satisfaction: The cases of 15 parks in Shanghai. *Chin. Landsc. Archit.* **2021**, *37*, 36–41. (In Chinese)
46. Spielhofer, R.; Hunziker, M.; Kienast, F.; Hayek, U.W. Does rated visual landscape quality match visual features? An analysis for renewable energy landscapes. *Landsc. Urban Plan.* **2021**, *209*, 104000. [CrossRef]
47. Fu, B.; Xiao, X.; Li, J. Big Data-Driven Measurement of the Service Capacity of Public Toilet Facilities in China. *Appl. Sci.* **2022**, *12*, 4659. [CrossRef]
48. Kadi, S.; Abdullah, A.; Bachok, S. The evaluation of pedestrian facilities on Hajj crowd between Arafat and Muzdalifah pedestrian street. *Plan. Malays.* **2021**, *19*, 169–179. [CrossRef]
49. Zhang, F.; Liu, Q.; Zhou, X. Vitality Evaluation of Public Spaces in Historical and Cultural Blocks Based on Multi-Source Data, a Case Study of Suzhou Changmen. *Sustainability* **2022**, *14*, 14040. [CrossRef]
50. Xue, B.; Xiao, X.; Li, J.L.; Zhao, B.Y.; Fu, B. Multi-source data-driven identification of urban functional areas: A case of Shenyang, China. *Chin. Geogr. Sci.* **2023**, *33*, 21–35. [CrossRef]