Study on the Planning of Shared Bicycle Parking Spots Based on Public Participation

Kunze Sha*, Wei Chen

School of Earth System Science, Tianjin University, Tianjin, 300072, China

*Corresponding author. Email: 13920063526@163.com

Abstract. The problem of indiscriminate parking of shared bicycles in major cities in China is becoming increasingly serious and needs to be solved urgently. This paper is based on public participation, through the social platform to issue a research questionnaire on the planning and layout of parking points, using the hierarchy analysis method (Analytic Hierarchy Process, AHP) for weighting analysis, the results show that the proximity to transportation hubs and districts of the distance, better visibility, away from the barrier-free access, such as the indexes of the weight is higher, and to provide references for the level of the parking point urban design, as a way to optimize the layout of parking spots. Finally, research on planning and programming and electronic fence management is carried out to provide solutions for the management of indiscriminate parking.

Keywords: Shared Bicycle; Parking Layout Planning; Public Participation; Analytical Hierarchy Process (AHP).

1 Introduction

In recent years, more and more cities both domestically and internationally have emerged with the emergence of shared bicycles as an emerging public transportation tool. The importance of shared bicycles in urban transportation has been increasing, solving the "last mile" problem of citizens' travel. However, shared bicycles have changed the way citizens travel, brought convenience to citizens, and also brought problems to urban development, especially the problem of shared bicycles being parked and misplaced indiscriminately, Occupying a large amount of public space in the city, blocking urban traffic, and bringing a lot of problems to urban governance, the main reason is that the parking spaces for shared bicycles have not been properly planned [1]. At this stage, only a few "no-parking zones" are delineated by the electronic fence in the software of the main bike-sharing operators, in other words, in addition to the "no-parking zones", as long as they are within the operating range of the city, all other areas are "permitted to park", which sows hidden dangers for the haphazard parking and discharging of shared bicycles. In addition, although some cities (Tianjin) have designated parking spaces for shared bicycles on the ground, the designation of the parking spaces is relatively unreasonable, such as the distance of the parking space

B. Siuta-Tokarska et al. (eds.), *Proceedings of the 2024 2nd International Conference on Management Innovation and Economy Development (MIED 2024)*, Advances in Economics, Business and Management Research 300,
https://doi.org/10.2991/978-94-6463-542-3_23

from the cyclist's destination is far away, the scale of some of the parking spaces is too small, which leads to the overflow of vehicles during peak hours, and the number of parking spaces is too small, and the layout is unreasonable, which leads to the spontaneous formation of a number of "parking lots", and even directly parked at random on the street [2]. In short, the parking problem of shared bicycle needs to be solved urgently, and there is an urgent need to strengthen the planning of shared bicycle parking, as well as the establishment of a corresponding system for the management of shared bicycle parking.

On the issues related to shared bicycles, scholars and experts have done a lot of research work in recent years. In terms of the selection of indicators for the impact analysis of shared bicycles, Xie Lingyan et al. conducted a weighted analysis based on demand points, road network density, accessibility and other factors [3-4]; Shi Xiaofa et al. determined the resident population in the study area by determining the demand for shared bicycles in the study area based on the previous citywide travel statistics, so as to equip parking spaces [1]. In terms of optimizing the parking of shared bicycles, Liang Mingwon crawls the peak time shared bicycle movement data according to the peak heat map of Chengdu shared bicycle, determines the scope of shared bicycle connection in metro stations of different scales, and carries out the layout planning for parking and surrounding elements from the perspective of urban design [5]; Chen Peichen crawls the Mobike displacement data in Xi'an to determine the locations of serious piling up of shared bicycles, areas of high frequency of use, and the locations of spontaneously formed "parking lots"[2]; Deng Lifan climbed Beijing shared bicycle data and Point of Interest (POI) data, at the same time, POI points delineated a buffer zone of different radii, according to the frequency of shared bicycles in the buffer zone within the end of the ride to determine the POI points and riding behavior of the connection tightness[6]; Guo Yanru and other scholars tried to determine the distribution of parking spaces by constructing algorithms [7-9].

To summarize, firstly, the relevant studies only effectively delineate the parking area for a certain area, and their delineation methods are not generalizable, such as the campus has certain special characteristics, and their delineation methods are not enough to be used for the layout of parking spots in the social surface. Secondly, the modeling of some of the studies is too complicated and highly abstracted from the actual problem, and only individual time sections are used for analysis, so the results are more accidental. Furthermore, some indicators are less convincing in terms of indicator selection. Therefore, the principle of shared bicycle parking spot layout is still not clarified, and there is still a certain gap in the research. In this paper, we firstly issue a research questionnaire through social platform based on public participation, and then construct a decision-making model influencing the location of parking spots through hierarchical analysis method (AHP), analyze the weight index of each influencing factor, and conduct cluster analysis for each influencing factor to screen the key influencing elements and non-key influencing elements, and finally provide a basis for the planning of parking spots and the guidance of urban design (Figure 1).

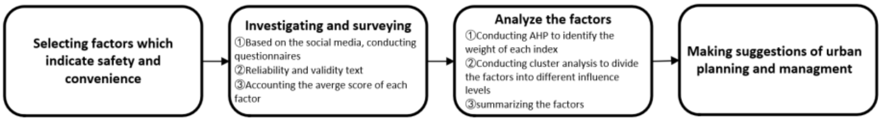

Fig. 1. Research Technology Roadmap

2 Analysis of the Decision-Making Model of Shared Bicycle Site Selection Based on Public Participation

2.1 Selection of Indicators

Decision-making model construction and indicator selection is an important step in the late parking planning and urban design guidance, so the selection of indicators should meet the following conditions [10]: (1) the independence of the factors affecting the indicators should be avoided as much as possible to interfere with each other; (2) the objective comprehensiveness of the text to establish the decision-making layer and the indicator layer, through the two-layer multifactor decision-making, prioritize the decision-making layer of the importance of the level of the decision-making process is not only objective and comprehensive, but also focus on the main direction of planning; (3) easy to perceive and quantify, this paper is based on the expert scoring method, to strengthen public participation, the use of questionnaires and research, through the network of social media platforms, the interviewees through the corresponding indicators of the importance of the recognition of the judgments, the scoring range of 1-10 points, 1 is the lowest degree of recognition, and 10 points is the highest; (4) Universality, because the urban environment is extremely complex, the selection of the corresponding indicators should be adapted to the universal evaluation requirements.

This study is based on the AHP to construct the decision-making model affecting the location of parking spots, analyze the weight of each indicator, and the indicator selection is firstly divided into two parts, which are the decision-level indicators and the indicator-level indicators. Decision-making indicators focus on the principles and direction of the layout of the parking spot, shared bicycle as a means of transportation for travel, first of all, safety, must ensure the safety of the user, followed by convenience, the invention of the shared bicycle is to solve the last kilometer, to facilitate the travel of the public. Indicator layer indicators refine the decision-making level, based on the pre-survey, in the safety-related indicators, to explore the public's perception of the possible impacts of pedestrian and vehicular traffic on riders and the related sources of hazards that may bring harm to riders; in the convenience-related indicators, to explore the urgency of the public's request for parking points close to destinations and places with a high demand for shared bicycles.

Combined with the results of related research [6], the evaluation model and indicator selection were finalized, and the comprehensive evaluation indicator A was divided into 2 B-level decision-making levels and 29 C-level decision-making levels (Table 1).

Table 1. Evaluation indicators for shared bicycle parking spots

Comprehensive Evaluation Indicators	Decision Level	Indicator Layer	Interpretation of Indicators
Shared Bicycle Comprehensive evaluation of site selection A	Security B1	Intersection Location C1	Parking spots should be located away from intersections for safety
		Motorway distance C2	Keep away from motorways to prevent traffic disruption
		Motorized and non-motorized separation zone C3	Avoid layout in the separation zone between motorized and non-motorized lanes
		Sidewalk Flow C4	Parking spots should be far away from roads with high pedestrian flow
		Line-of-motion visibility C5	Parking spots should meet the requirements of better visibility for pedestrians, motorized vehicles, non-motorized vehicles and other traffic flows that may have an impact on parking, to prevent traffic accidents caused by parking
		Barrier-free access C6	Away from blind or barrier-free access
		Greening C7	Away from plants that need to be sprayed with pesticides or poisonous plants to prevent damage to bicycles and health hazards to cyclists.
		Hazardous Facilities C8	Keep away from dangerous facilities, such as high-voltage power poles
		Billboards C9	Keep away from hanging billboards to avoid falling in windy weather.
		Dangerous Trees C10	Keep away from poorly grown trees to prevent them from breaking and causing harm to the parking spot.
		Utility Wells C11	Keep away from utility wells to prevent damage to or loss of their covers.
		Street Frontage Buildings C12	Keep away from buildings facing the street to prevent falling objects.
		Protected Buildings C13	Keep away from protected buildings or old trees
		Construction Site C14	Away from building sites or construction zones
		Slow-moving road C15	Layout on both sides of side streets or roads with slow-moving cars
	Convenience B2	Destination C16	Stay close to your destination, within 100 meters if possible
		Road crossing C17	Avoid crossing the road from the nearest parking spot to the destination
		Transportation Interchange C18	Prioritize parking spots at transportation access points.
		Residential neighborhoodsC19	Priority should be given to the entrances and exits of neighborhoods
		Shopping CenterC20	Priority should be given to shopping malls or large shopping centers
		Small Shops C21	Priority should be given to small restaurants and daily necessities stores.
		Park C22	Priority is given to parks or riverfront green spaces.
		Hospital C23	Priority should be given to hospital entrances and exits
		Secondary SchoolsC24	Priority should be given to secondary school entrances
		Elementary Schools and Kindergar-tensC25	Priority should be given to elementary school and kinder-gartens
		Sports VenuesC26	Priority should be given to gymnasiums
		Rainproof C27	Try to locate in places with rain-proof facilities (e.g. eaves, under overpasses).
		Environmental HarmonyC28	Parking spots should be in harmony with the surrounding environment
		Shade C29	Prioritize parking spots in areas covered by shade trees

2.2 Model Construction and Weighting Analysis

In line with the principle of public participation, research on the public's perception of the importance of the factors affecting the layout of shared bicycle parking points, through the social platform for network questionnaire distribution, a total of 96 copies of the questionnaire received, received 92 valid answers, accounting for 95.83%. Most of the respondents fill out the questionnaire seriously, the information reflected is real and effective, overall the questionnaire is issued in large quantities and filled out in high quality, with strong persuasive power, which can be used for subsequent analysis. To calculate the average score of each indicator, the score of each question is shown in Table 2.

Table 2. Table of mean scores for each question of the questionnaire

Decision Level	Average Score	Indicator Layer	Average Scores
Security B1	8.39	Intersection Location C1	7.05
		Motorway distance C2	7.82
		Motorized and non-motorized separation zone C3	7.42
		Sidewalk flow C4	4.93
		Line-of-sight visibility C5	8.17
		Barrier-free access C6	8.16
		Greening C7	7.24
		Hazardous facilities C8	8.00
		Billboards C9	7.79
		Dangerous Trees C10	7.03
		Utility Wells C11	7.37
		Street Frontage Buildings C12	7.20
		Protected Buildings C13	6.62
		Construction Site C14	7.37
		Slow-moving Roads C15	7.17
Convenience B2	8.59	Destination C16	7.74
		Road crossing C17	7.45
		Transportation Interchange C18	8.46
		Residential neighborhoods C19	8.17
		Shopping Center C20	7.99
		Small Shops C21	7.16
		Park C22	7.40
		Hospital C23	7.62
		Secondary SchoolsC24	7.80
		Elementary Schools and KindergartensC25	5.79
		Sports VenuesC26	6.87
		Rainproof C27	7.57
		Environmental HarmonyC28	7.12
		Shade C29	6.54

The results of the questionnaire were analyzed for reliability and validity through SPSSAU software, in which the Cronbach α coefficient was 0.964, which was greater than 0.8, and the questionnaire was highly reliable; The KOM value was 0.888, which was greater than 0.8, corresponding to a p-value of 0.000, which was less than 0.05, and the validity was very high through the Bartlett's test, so the questionnaire had a very high degree of reliability and validity (Tables 3 and 4). Hierarchical analysis method (AHP) for site selection decision through yaahp platform, the results were obtained as shown in figure 2, table 5 and table 6.

Table 3. Questionnaire reliability test table

Cronbach's Reliability Analysis		
Number of items	Sample size	Cronbach αcoefficient
31	92	0.964

Table 4. Questionnaire validity test table

KMO and Bartlett's Test		
KMO value		0.888
Bartlett Sphericity Check	Approximate cardinality	2866.542
	df	465
	p value	0.000

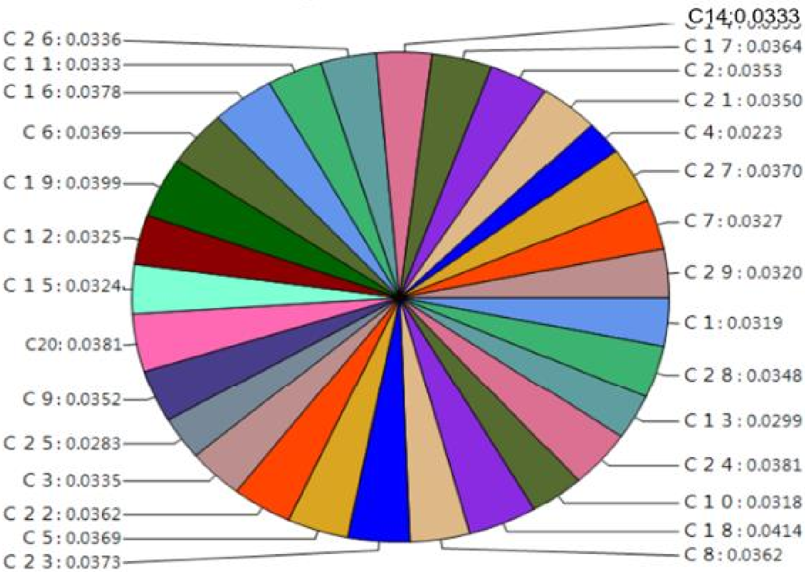

Fig. 2. Weighting analysis of indicator layer based on yaahp platform

Table 5. Ranking of indicator layer weighting analysis

Indicator level	Weights	Indicator level	Weights
C18	0.0414	C28	0.0348
C19	0.0399	C26	0.0336
C24	0.0381	C3	0.0335
C 2 0	0.0381	C11	0.0333
C16	0.0378	C14	0.0333
C23	0.0373	C7	0.0327
C27	0.0370	C12	0.0325
C5	0.0369	C15	0.0324
C6	0.0369	C29	0.0320
C17	0.0364	C1	0.0319
C22	0.0362	C10	0.0318
C8	0.0362	C13	0.0299
C2	0.0353	C25	0.0283
C9	0.0352	C4	0.0223
C21	0.0350		

Table 6. Decision-making weighting analysis ranking table

Decision-making	Weights
B2	0.5059
B1	0.4941

2.3 Analysis of Statistical Results Based on Hierarchical Analysis Method (AHP)

For the decision-making level, the degree of influence of convenience is slightly greater than that of safety, the consistency ratio (CR) is less than 0.1, and its consistency is acceptable, the factor weights and consistency test are shown in Table 7.

Table 7. Consistency test table of factor weights at the decision level

A	B1	B2	Wi
B1	1	0.9767	0.4941
B2	1.0238	1	0.5059

Note: Consistency ratio: 0.0000; Weight on A: 1.0000; λmax: 2.0000

For the safety indicator layer, the overall weight of this group of indicators is low, the consistency ratio (CR) of this discriminant matrix is less than 0.1, and its consistency is acceptable, and the factor weights and consistency test are shown in Fig. 3. For the convenience indicator layer, the consistency ratio (CR) of this discriminant matrix is less than 0.1, and its consistency is acceptable, and the factor weights and consistency test are shown in Figure 4.

B1	C1	C7	C13	C4	C10	C2	C8	C14	C5	C11	C3	C6	C9	C12	C15	Wi
C1	1	0.9738	1.065	1.43	1.0028	0.9015	0.8813	0.957	0.8629	0.9566	0.9501	0.864	0.905	0.9792	0.9833	0.0645
C7	1.027	1	1.0937	1.4686	1.0299	0.9258	0.905	0.982	0.8862	0.9824	0.9757	0.8873	0.9294	1.0056	1.0098	0.0662
C13	0.939	0.9144	1	1.3428	0.9417	0.8465	0.8275	0.898	0.8103	0.8982	0.8922	0.8113	0.8498	0.9194	0.9233	0.0605
C4	0.6993	0.6809	0.7447	1	0.7013	0.6304	0.6163	0.669	0.6034	0.6689	0.6644	0.6042	0.6329	0.6847	0.6876	0.0451
C10	0.9972	0.971	1.0619	1.426	1	0.899	0.8788	0.954	0.8605	0.9539	0.9474	0.8615	0.9024	0.9764	0.9805	0.0643
C2	1.1092	1.0801	1.1813	1.5862	1.1124	1	0.9775	1.061	0.9572	1.0611	1.0539	0.9583	1.0039	1.0861	1.0907	0.0715
C8	1.1348	1.105	1.2085	1.6227	1.138	1.023	1	1.086	0.9792	1.0855	1.0782	0.9804	1.027	1.1111	1.1158	0.0732
C14	1.0454	1.018	1.1133	1.4949	1.0484	0.9425	0.9213	1	0.9021	1	0.9933	0.9032	0.9461	1.0236	1.0279	0.0674
C5	1.1589	1.1285	1.2341	1.6572	1.1622	1.0448	1.0213	1.109	1	1.1085	1.1011	1.0012	1.0488	1.1347	1.1395	0.0747
C11	1.0454	1.018	1.1133	1.4949	1.0484	0.9425	0.9213	1	0.9021	1	0.9933	0.9032	0.9461	1.0236	1.0279	0.0674
C3	1.0525	1.0249	1.1208	1.5051	1.0555	0.9488	0.9275	1.007	0.9082	1.0068	1	0.9093	0.9525	1.0306	1.0349	0.0679
C6	1.1574	1.1271	1.2326	1.6552	1.1607	1.0435	1.02	1.107	0.9988	1.1072	1.0997	1	1.0475	1.1333	1.1381	0.0746
C9	1.105	1.076	1.1767	1.5801	1.1081	0.9962	0.9738	1.057	0.9535	1.057	1.0499	0.9547	1	1.0819	1.0865	0.0712
C12	1.0213	0.9945	1.0876	1.4604	1.0242	0.9207	0.9	0.977	0.8813	0.9769	0.9704	0.8824	0.9243	1	1.0042	0.0658
C15	1.017	0.9903	1.0831	1.4544	1.0199	0.9169	0.8963	0.973	0.8776	0.9729	0.9663	0.8787	0.9204	0.9958	1	0.0656

Fig. 3. Consistency test table for factor weights in the safety indicator layer

Note: Consistency ratio: 0.0000; Weight on A: 0.4914; λmax: 15.0000

B2	C20	C19	C25	C16	C22	C26	C23	C17	C18	C21	C24	C27	C28	C29	Wi
C20	1	0.9535	1.3454	1.0065	1.0527	1.1339	1.0223	1.046	0.9208	1.088	0.9987	1.0291	1.0941	1.1911	0.0753
C19	1.0488	1	1.4111	1.0556	1.1041	1.1892	1.0722	1.097	0.9657	1.1411	1.0474	1.0793	1.1475	1.2492	0.079
C25	0.7433	0.7087	1	0.7481	0.7824	0.8428	0.7598	0.777	0.6844	0.8087	0.7423	0.7649	0.8132	0.8853	0.056
C16	0.9936	0.9474	1.3368	1	1.0459	1.1266	1.0157	1.039	0.9149	1.081	0.9923	1.0225	1.0871	1.1835	0.0748
C22	0.9499	0.9058	1.2781	0.9561	1	1.0771	0.9711	0.993	0.8747	1.0335	0.9487	0.9775	1.0393	1.1315	0.0715
C26	0.8819	0.8409	1.1865	0.8876	0.9284	1	0.9016	0.922	0.8121	0.9595	0.8808	0.9075	0.9649	1.0505	0.0664
C23	0.9782	0.9327	1.3161	0.9845	1.0297	1.1092	1	1.023	0.9007	1.0642	0.9769	1.0066	1.0702	1.1651	0.0736
C17	0.9564	0.9119	1.2867	0.9625	1.0068	1.0844	0.9777	1	0.8806	1.0405	0.9551	0.9841	1.0463	1.1391	0.072
C18	1.086	1.0355	1.4611	1.093	1.1432	1.2314	1.1102	1.136	1	1.1816	1.0846	1.1176	1.1882	1.2936	0.0818
C21	0.9191	0.8764	1.2366	0.9251	0.9676	1.0422	0.9396	0.961	0.8463	1	0.9179	0.9458	1.0056	1.0948	0.0692
C24	1.0013	0.9547	1.3472	1.0078	1.0541	1.1354	1.0236	1.047	0.922	1.0894	1	1.0304	1.0955	1.1927	0.0754
C27	0.9718	0.9266	1.3074	0.978	1.023	1.1019	0.9934	1.016	0.8948	1.0573	0.9705	1	1.0632	1.1575	0.0732
C28	0.914	0.8715	1.2297	0.9199	0.9622	1.0364	0.9344	0.956	0.8416	0.9944	0.9128	0.9406	1	1.0887	0.0688
C29	0.8395	0.8005	1.1295	0.845	0.8838	0.952	0.8583	0.878	0.773	0.9134	0.8385	0.8639	0.9185	1	0.0632

Fig. 4. Consistency test table for factor weights of convenience indicator layerSPSS-Based Indicator Classification and Priority Indicator Extraction

Note: Consistency ratio: 0.0000; Weight on A: 0.5059; λmax: 14.0000

As the indicator layer has more indicators and the weights are closer, in order to extract the main impact indicators, the author adopts the systematic clustering method based on SPSS 25, extracts the main indicators according to the spectral graph (Figure 5, Table 8), groups them according to the position of the red line through the graph, and according to the weight of the indicators sorted from the highest to the lowest, the indicator layer can be sequentially divided into 6 groups.

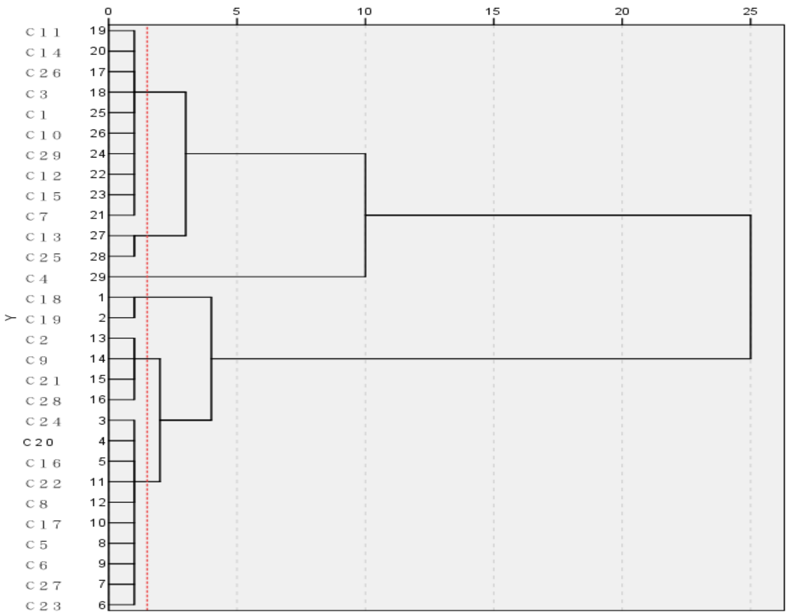

Fig. 5. Spectral map of cluster analysis at the indicator level

Table 8. Indicator weighting hierarchy

Impact	Factor	Factor Type Description
Very significant	C18 Transportation Interchange C19 Residential neighborhoods	Places with very high foot traffic, which is a major consideration in the planning of parking spots and determines the layout of the plan
More significant	C24 Secondary School C20 Shopping Centers C16 Destinations C23 Hospitals C27 Rain Protection C5 Mobility Visibility C6 Accessibility C17 Road Crossing C22 Parks C8 Hazardous Facilities	Most of the indicators in the B2 convenience layer, as well as those that have a significant impact on security
Generally significant	C2 Motorway distance C9 Billboards C21 Small stores C28 Environmental coherence	Low-traffic locations and elements that do not have a prominent impact on convenience and safety
Less significant	C26 Sports Complex C3 Mechanical non-separation zone C11 Water and electricity wells C14 Construction site	Sites that are less frequently visited by bicycle in daily life are mostly irrelevant for elements that have a general impact on safety

	C7 Greening C12 Street Frontage Building C15 Slow-moving road C29 Shade C1 Intersection Location C10 Hazardous Trees	
Not significant	C13 Protection of buildings C25 Primary Schools and Nurseries	Indicators are unfamiliar to the respondents (C13), or the public has different opinions about them (C25).
Extremely insignificant	C4 sidewalk flow	Public opinion on this is widely divided (C4)

3 Preliminary Planning for Parking Spots

3.1 Analysis of Key Elements of Shared Bike Parking Spots

Based on the weights of the factors at the decision level, the weight of convenience (0.5059) is higher than that of safety (0.4901), indicating that as an emerging transportation means to solve the last kilometer of urban transportation, convenience is the most fundamental, and the layout of the parking spot should satisfy the public's travel needs to the maximum extent. And on the basis of convenience, security is considered according to the specific environment around the parking spot to protect public life and property safety and road traffic safety.

Transportation transfer points and residential neighborhoods are the primary influence elements, is very significant, respectively, 0.0414 and 0.0399, higher than all other factors that determine the planning layout. Preliminary analysis of the reasons, bike sharing has a strong convenience-oriented these two are daily urban life in the largest flow of people in the place, especially in residential neighborhoods morning peak as the source of the flow of people, the evening peak for the sink, so these locations must be laid out parking points and capacity should meet the corresponding demand. In addition, most of the other indicators of convenience are located in the more significant group, indicating that priority should be given to convenience, as close as possible to destinations with high pedestrian flow, and bike sharing meets the daily travel needs of residents, which is consistent with the results of the previous research.

Safety of which C5 (line visibility, weight 0.0369), C6 (barrier-free access, weight 0.0369), C7 (dangerous facilities, weight 0.0327) is also more significant, indicating that the traffic flow within the city is large, with a good view, not only can make the parker easy to identify the parking space, reduce the phenomenon of indiscriminate parking, while allowing pedestrians, vehicles and other traffic flow Attention to the parking spot, is the key to avoid traffic accidents; In addition should also be away from the barrier-free access, pay attention to vulnerable groups, to avoid crossing the line of motion with the mobility-impaired people, which will be a lot of inconvenience; But also should be away from some dangerous facilities, to avoid the safety hazards in order to protect the cyclist's life and property safety. Although in the questionnaire survey, the weight of the decision-making level security is lower than convenience, and the weight of security indicators is generally lower than convenience (the highest weight of security indicators C5 line visibility, C6 barrier-free access, the weight of 0.0369, ranked 8th). However, it does not mean that the public ignores security, let alone indicating that security does not need to be considered too much in the process of planning, but rather security should be considered on the basis of convenience, because convenience and security have different scales, and convenience emphasizes the layout of siting factors, which are larger in scale. In the specific delineation of the location of parking spots, security is an important factor, and the scale is smaller; therefore, on the basis of convenience, the above security indicators should be emphasized in the light of the surrounding environment of the parking spots.

3.2 Urban Design Guidance

3.2.1. Parking Spots Should be Prioritized in High-Traffic Locations.

The main function of shared bicycle is to solve the urban transportation problem, convenience is its most basic attribute, but the built-up areas of major cities are often tight land, the street can use less space, so on the basis of guaranteeing convenience, should be accurate, reasonable and effective layout of shared bicycle parking points, to ensure its efficient use, to avoid the waste of land. Therefore, priority should be given to the layout in places with large flow of people, especially transportation interchanges and residential areas, which are often the places with the largest flow of people in urban commuting, and are also the basic layout framework of shared bicycle parking points in various cities.

3.2.2 Parking Spots Away from Dangerous Facilities, Focusing on Road Traffic Safety.

Convenience as the basis of the layout of the parking point, on the basis of convenience to improve safety, pay particular attention to the visibility of the parking point, reduce the parking point visual blind spot, especially the parking point for the visual blind spot of the motor vehicle, as far as possible and the motor vehicle route separation, in addition to that, but also with the pedestrian line of motion to reduce the cross, away from the barrier-free facilities, to reduce the passage of the mutual interference, to avoid traffic accidents. Stay away from dangerous facilities, such as high-voltage lines and other areas that may cause harm to the personal safety of users of shared bicycles, to avoid potential safety hazards.

4 Conclusion

This paper analyzes the layout of shared bicycle parking spots, in line with the principle of public participation, with the help of online social platform questionnaire research, through the hierarchical analysis method (AHP), cluster analysis and other methods to analyze the influence of the layout of shared bicycle parking spots and the importance of each factor, to provide reference for the layout planning of shared bicycle parking spots. The article found that: the influence of factors such as places with large flow of people, visibility and barrier-free access is significant. Therefore, the parking spots should be set up in places with large flow of people, emphasize on visibility, and avoid being close to barrier-free access and dangerous facilities.

References

1. Shi Xiaofa, Yang Wenhui. Design and Planning of Shared Bicycle Parking Area--The Case of South Pier Road Street [J]. Comprehensive Transportation, 2019, 2: 116-121.
2. Chen Peichen, Dong Xin. Multi-party co-management: research on optimization strategy of shared bicycle parking in Xi'an -analysis based on Mobike web crawler data [J]. Modern Urban Research, 2019.6: 2-8.
3. Xie Lingyan. Exploration of Campus Shared Bicycle Parking Spot Setting -Taking South China Normal University Shipai Campus as an Example [J]. Technology and Innovation, 2019(11):56-60.
4. Li Linfeng, Li Jinqiang, Geng Lian. GIS-based site selection planning for urban shared bicycle virtual station - taking Minjiang College campus as an example [J]. Smart City, 2019(20):4-8.
5. Liang Mingyuan, Wang Guan. Research on shared bicycle parking space around rail transit stations in downtown Chengdu [J]. Planner, 2019(18):54-61.
6. Deng Lifan, Xie Yonghong, Huang Dingxi. Research on Shared Bicycle Facility Planning Based on Riding Spatio-Temporal Data [J]. Planner, 2017(10):82-88.
7. Guo Yanru, Luo Zhixiong, Wang Jiachuan et al. Research on data-driven planning method of shared bicycle parking area [J]. Transportation Systems Engineering and Information, 2021(6):9-16
8. Zuo Ni Na. Research on optimal distribution of urban shared bicycle based on cluster intelligent optimization algorithm [J]. Modern Electronic Technology, 2021, 44 (11):115-119.
9. Shi Jiawei, Chen Guanlin, Xu Huang. Application of improved genetic algorithm in shared bicycle parking spot allocation [J]. Sensors and Microsystems, 2019 (38): 154-160.
10. Li Faming. Research on value evaluation and protection of geologic relic landscape [D]. Tianjin: Tianjin University, 2019.