

## Article

# Post-Occupancy Evaluation of Brownfield Reuse Based on Sustainable Development: The Case of Beijing Shougang Park

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**Abstract:** Industrial heritage parks, an effective form of urban brownfield reuse, effectively mitigate pollution, improve the human living environment, and achieve sustainable development; industrial heritage parks, which add blue and green space to a city, also play an important role in presenting urban history and culture, promoting regional economic growth, and achieving human well-being. Exploring the user behavior use of industrial heritage parks and conducting post-occupancy evaluation of projects based on subjective human perceptions from the users' perspective can contribute to improve the sustainable management, maintenance, and design of projects in the future. However, previous studies on post-occupancy evaluation have not been sufficiently studied for urban industrial heritage parks. This study takes Beijing Shougang Park, a representative industrial heritage park in China, as the research object, and distributes and collects nearly 150 questionnaires about user behavior and four significant evaluation items after the preliminary field research, analyzes the importance and satisfaction evaluation of the park design elements (place characteristics, natural environment characteristics, usability characteristics, and management characteristics), and uses a frequency analysis, an IPA analysis, an independent *t*-test, an analysis of variance, and a multiple regression analysis, and other methods are used, to quantitatively analyze the content of the questionnaire. The results of the study include the following: (1) The park is mainly used by people in their twenties to thirties and forties, and the usage rate of the sports plaza, which is the main facility, is the highest, while the usage rate of the renovation facility, the machine room, is the lowest. (2) While Shougang Park users were more satisfied with the natural environment features, Shougang Park users were found to be relatively less satisfied with the place and usability features. (3) The natural environment characteristics of Shougang Park had a positive effect on both overall satisfaction and recommendation intention. Finally, based on the questions and suggestions from users, a park renewal optimization strategy is proposed, hoping to provide suggestions for the renovation and design of similar industrial heritage parks in Chinese cities.

**Keywords:** industrial heritage transformation; post-occupancy evaluation; user perception; Shougang Park



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## 1. Introduction

A large number of industrial areas have been built in the suburbs of cities around the world in the process of modern industrialization, and China is no exception. The rapid increase in urban area in China's urbanization process has led to the coexistence of industrial areas with new urban blocks around them, which in turn has reduced the quality of the human living environment, violated the concept of sustainable development, and negatively affected the urban image. With the introduction of national macro-control and policies, which emphasize the transformation of urban functions and focus on environmental sustainability, industrial areas are gradually moving out of cities, while the industrial heritage left behind is facing the situation of idleness and abandonment, eliminating the negative effects of brownfield sites on urban development, and actively protecting industrial heritage is important and significant for revitalizing cities.

Industrial heritage, which symbolizes human civilization and serves as a medium of human history, has become an important element of natural and cultural heritage [1] in cities of various countries. Industrial heritage was defined as “industrial monuments” in 1970, and in November 1972, The United Nations Educational, Scientific and Cultural Organization (UNESCO) adopted the Convention for the Protection of the World Heritage, and in 1973, TICCIH was established to advise UNESCO on industrial heritage. In 2003, the International Committee for the Conservation of Industrial Heritage (TICCIH) created *The Nizhny Tagil Charter for the Industrial Heritage* to define industrial heritage as follows: Industrial heritage consists of the remains of industrial culture about historical, technical, social, architectural, or scientific significance. These monuments include buildings and machinery, workshops, mills and factories, mines and processing and refining sites, warehouses and depots, sites of energy production, transmission and use, transportation and all its infrastructures, as well as sites used for social activities related to industry, such as housing, religious worship, or an educational place [2], which is classified as an important type of heritage [3,4]. In the 1990s, Europe and the United States, in order to solve the economic decline in inner cities and many social problems, set off a wave of urban center revitalization to promote urban renaissance through the adaptive reuse of industrial heritage, and usually the industrial heritage is created as a high-quality urban public space, so as to create favorable conditions for the activation of the economy of the inner city [5]. Since the continuous development of the US National Regional Heritage in 1984, industrial heritage preservation has become an important component of it [6]. In the UK, industrial heritage conservation is guided by the sustainable development rules, which insist on the two key points of “the use of a long-term” and “holistic planning process” in the concept of sustainability [7,8].

In Germany, industrial heritage is actively combined with heritage tourism to develop new forms of urban tourism based on culture and activities in the context of urban regeneration, which has an important impact on the environment, economy, and culture [9]. The “transformation and reuse of industrial heritage” itself is a “verb” with a wide range of values, which is closely linked to urban development and planning, and socio-economic development [10,11]. Industrial heritage is a process through which objects, events, places, customs, personalities, and their interpretations from the past are transformed into present and current experiences, and it is also the result of the deliberate creation of current political, social, or economic demands. Heritage defined in this way must be understood from the outset not only as a method but also as a means of understanding the present past, through the preserved tangible and intangible critical links between past and present [1]. The creation of urban public landscape spaces based on industrial heritage perpetuates industrial civilization, reshapes regional ecology, and stimulates rational thinking about urban development and environmental protection [12]. Brownfield redevelopment, with the goal of urban revitalization, industrial heritage parks have a positive impact on the surrounding area’s housing prices [13], increase employment opportunities to reduce unemployment [14], and improve the level of local residential security [15], and in particular, the distinctive public space presented by the transformation of the industrial heritage incorporating green and natural elements exceeds the existing park function, highlighting the unique value of post-industrial society.

China entered the peak of urban construction in the 1990s, and the rapid urban expansion led to the demolition of a large number of factories and industrial buildings in the inner cities, which erased the unique urban memory and industrial civilization they contained, and government agencies gradually realized the importance of industrial heritage as historical and cultural heritage, and started the road of industrial heritage conservation. The adoption of the *Wuxi Recommendations* constitution, which aimed to increase industrial heritage conservation efforts, was a milestone for industrial heritage conservation in China [12], marking a new step in industrial heritage conservation in China.

Industrial heritage is an essential part of cultural heritage, and community participation in heritage management and public participation in heritage transformation projects

can promote sustainable urban development in an inclusive and dynamic way [8,16,17]. In recent years, China has built a large number of industrial heritage parks for industrial heritage conservation and utilization, but the maintenance and management of industrial heritage parks mainly rely on top-down cooperation between government agencies and profit-driven corporate groups [8,18–20], and the lack of feasible management policies and effective evaluation tools makes it difficult to achieve sustainable development. The adoption of POE helps to improve the sustainable management of a park and plays an important role in the high level of development of the heritage park.

The Opium War of 1840 initiated the industrial development of modern China, and the famous city of Beijing was the first to witness the tremendous impact of Western industrial civilization during the late Qing Dynasty, becoming one of the early cities in China to move towards industrialization [21]. The industrial economy of modern Beijing developed after 1949, when the capital city was led by the strategy of “transforming from a consumer city to an industrial city”, and modern industry developed rapidly and played an important role in some key national industrial sectors [22]. Since China’s reform and opening up, many large industrial enterprises have faced severe trials with the reform of the national economic system and the transformation of urban land functions, and have gradually declined in development.

At the beginning of the 21st century, the capital city of Beijing took four centers as its strategic positioning, which are the national political center, cultural center, international communication center, and science and technology innovation center. In 2003, in order to promote the development transformation of the capital of Beijing and environmental protection, and to support the bid for the 2008 Olympic Games, Shougang made a decision to relocate its main plant, and Shougang submitted a “relocation report” to the State Council and received approval. In 2010, the main plant of Shougang officially ceased production, and the old site was transformed and developed [23]; since then, the Shougang Industrial Zone has been upgraded and transformed, and the remaining industrial sites will be transformed into the Shougang Modern Industrial Heritage Cultural Zone, and this initiative will help Beijing Shijingshan District to become a national industrial transformation and development demonstration area, a green and low-carbon integrated service area in the western part of the capital, and an ecological livability demonstration area with the integration of landscape and culture [24], and the success of the 2022 Beijing Winter Olympics will accelerate the transformation and development of Shougang Industrial Heritage Park. The transformation of Shougang Industrial Heritage Park is an important tool for the urban revitalization of the Shijingshan Industrial Zone, and will become a new landmark for the urban revitalization of Beijing.

This study aims to firstly review the content of industrial heritage park renovation about brownfield reuse, and sort out the development status of urban industrial heritage renovation design at home and abroad, and secondly, to summarize and refine the design method of an industrial heritage renovation park based on the summary of the literature. Finally, we take Beijing Shougang Park as a case study and discuss the results based on the questionnaire of the park design and data analysis based on the users’ feeling, so as to provide corresponding references for the design of industrial heritage renovation in similar cities in China.

## 2. Materials

The methods of previous studies on post-occupancy evaluation of industrial heritage parks are not different from post-evaluation studies of general parks, which only analyze the frequency of users’ usage behavior and satisfaction evaluation of park usage. In order to solve these problems, this study improves the shortcomings of previous studies and aims to carry out the following tasks: (1) We aim to understand the content of relevant domestic and foreign industrial heritage park research, analyze the subjective feelings of users from the perspective of environmental behavior and environmental psychology, use human-centered thinking, discover existing problems in the park and summarize industrial heritage park

design practices, and finally review and discuss the current situation of industrial heritage park development in China. (2) This study establishes an evaluation system for the design criteria and elements of industrial heritage parks through the collation of the literature and the analysis of evaluation indicators. (3) Based on statistical analysis techniques, the reliability of the returned questionnaires was verified, and frequency analysis, IPA analysis, *t*-test, ANOVA, and multiple regression analysis methods are used for the park evaluation elements, and then the results of the questionnaires are analyzed. (4) Based on the evaluation of users' usage and feelings in the industrial heritage park, the strengths and weaknesses of the design factors are explored, and then modifications are proposed to provide reference for future industrial heritage park design.

### *2.1. Cases about Industrial Heritage Parks Based on Brownfield Reuse*

Brownfield regeneration is strongly linked to urban development and expansion. Brownfield sites, once located in the periphery—suburban sites—have become the heart of new cities due to their unique geographical transportation advantages and commercial nodes [25,26], while brownfield sites have stalled urban development due to industrial waste and industrial activities that produce potentially toxic substances that pollute the surrounding environment. Based on the principle of conservation and rehabilitation, industrial heritage parks have become one of the effective ways to reuse brownfield sites.

The prominent contradiction makes the research and practice of brownfield reuse an effective means of urban revitalization and will contribute to realize the coordination of economic and social development and sustainable urban development. Many European and American countries pay attention to the development and reuse of brownfield sites, and the official government, various enterprises, and urban residents participate in the transformation and utilization of brownfield sites. This is based on highly urbanized development with a gradual approach starting with ecological restoration, and the systematic study of brownfield reuse also opens up the road of urban industrial heritage landscape transformation [26]. In the post-industrial era, the principle of brownfield transformation in Western cities was mostly to convert them into urban green areas, and a large number of cases were produced from the 1960s to 1990s, and the design guidelines for brownfield reuse ranged from reasonable preservation and transformation based on industrial heritage to the introduction of earth art and the application of natural ecological techniques, which made the transformation of Western industrial heritage parks more and more mature and provided a basis for cities in Eastern countries to make reference to and design industrial heritage transformation. Relatively speaking, the transformation of industrial heritage parks in China started late in the 1990s, and the design of industrial heritage park transformation is a little thin, only satisfying the practical needs of a single recreation, lacking holistic and comprehensive design thinking, but it can be seen that there is a broad prospect and great potential for the transformation and utilization of brownfield sites, so it is necessary to learn from the successful experience of industrial heritage transformation and maintenance in Europe and the United States; for this reason, we analyzed and summarized the classic cases in Europe and the United States here, and at the same time, it is also necessary to combine our own situation to show unique industrial history and cultural characteristics and create industrial heritage parks with Chinese characteristics.

The retrofit design approach in these cases is based on the idea of industrial heritage reuse. The 1975 Seattle Gas Works Park in the United States is the beginning of the transformation of industrial site parks in the world. On the basis of respecting the original appearance and history of the industrial waste land, it adopts the design practice of minimal intervention; “interprets” rather than “designs” to the unique historical sites, industrial buildings, and park landscapes; integrates and realizes the site's self-evolution; reveals the historical and cultural connotation of the industrial heritage; and explores the beauty of the industrial characteristics, with its transformation practices featured including the demolition of some of the buildings, the retention of the tower, its transformation into a park landmark, and the adoption of biological phytoremediation technology.

The former New York High Line Park in the United States was a railroad freight line connecting the meat processing area and the port; now, the High Line expresses the idea of the ecological city concept and planting concept to people through the creation of a new public landscape park in the city, and the main renovation practices are to retain the crisscrossing railroad tracks, add concrete and landscape green belts, set up a number of entrances and exits, and emphasize the openness of the space [27].

Buerg Hafeninsel park in Saarbrücken, Germany adopts the concept of ecological treatment; “Landscape Architecture” guides the design of the redevelopment and maintenance of the character of the area with minimal intervention rather than major demolition and construction; the main renovation methods are the reuse of waste materials and the ingenious integration of waste building materials and plants, which solves the problem of severely damaged and declining areas [28].

Park Duisburg, located in Germany, which was formerly home to steel mills, coal mines, and the iron and steel industry, adopts the design concepts of closely integrating ecological green space with the original functions, integrating with the industrial heritage, emphasizing the value of industrial culture, and advocating the preservation and utilization of abandoned industrial sites and facilities; the main renovation methods are to comprehensively protect the overall layout and spatial structure of the old factory area, retain and comprehensively utilize a variety of abandoned industrial facilities, and build multiple landscape levels into landscape space [29].

Citroën Park in Paris, France, which was formerly a Citroën industrial automobile factory, adopts a new architectural and planning design to form a landscape volume on the industrial wasteland, and introduces diagonal axes on the site, following the baroque style landscape design techniques, and finally embodies unique industrial landscape qualities; the main approach is to demolish the original industrial buildings, connect the spaces of various sites in the park through the axes, and the symbolic reconstruction of the buildings [30].

## 2.2. About the Development and Status of Industrial Heritage Parks in China

Since China’s reform and opening up in 1978, China has experienced a wave of globalization and rapid urbanization expansion, and the Chinese metropolis is facing opportunities and challenges of economic restructuring and transformation of important industries. The closure and decommissioning of factories, docks, railroads, and some old public facilities have led to a large amount of unused land and housing [31], especially many old industrial plants that have undergone demolition and then disappeared. Under the urban development and renewal, the pollution of urban industrial abandoned sites and the social problems caused by it have made the government and people gradually realize that the transformation of industrial heritage parks is urgent. Transforming industrial heritage into industrial heritage parks in cities is an effective means to preserve industrial heritage and reuse brownfield sites for urban revitalization. Industrial heritage parks can improve the environment of brownfield sites and increase land use efficiency, improve the urban ecological environment, and enhance the quality of human living.

With the intervention of the big event of the 2022 Beijing Winter Olympic Games, it accelerated the construction of the industrial heritage park of Shougang Park, and at the same time, will be closely integrated with the organic renewal and green development of Shougang Park, making the cultural connotation development of Shougang Industrial Park more diversified and rich. Industrial heritage is an important carrier of industrial culture; for this reason, in order to better promote the protection and utilization of industrial heritage, the Ministry of Industry and Information Technology of the People’s Republic of China, the National Development and Reform Commission, and other remaining six state departments jointly issued the *Implementation Plan for Promoting the Development of Industrial Culture (2021–2025)* to actively explore the industrial protection and utilization system, and the Ministry of Industry and Information Technology of the People’s Republic of China from January 2017 to 2023 has been actively developing policies regarding the preservation



and renewal of industrial sites, in addition to the Beijing government promoting policies related to industrial heritage maintenance, and urban industrial heritage parks are one of the main forms of its effective development and promotion. Urban industrial heritage parks are a significant tool for urban revitalization and driving coordinated regional development. With the support of the municipal government and local governments, more and more urban industrial heritage parks will be built and land within the Beijing city in the future.

### *2.3. Park Evaluation Indicators on Urban Industrial Heritage Renovation*

Generally speaking, there is literature about the landscape design of urban parks based on the transformation of industrial heritage, which involves more relevant theories, and more varieties of content are also particularly rich. By defining the research object of Shougang Park, it is possible to more accurately analyze the elements of industrial landscape design of steel mills based on industrial heritage renovation, through the literature related to the landscape design of industrial renovation of Shougang Park [24,32], the theory of the design of urban parks based on the renovation of industrial heritage [26,33], as well as the “Post-industrial Landscape Design and Urban Renewal” [34–38], and scholars have summarized the landscape design research on industrial heritage, and refined Part A “industrial spirit of place-based features”, Part B “natural elements and environmental features”, Part C “utility features”, and Part D “park management and maintenance features”, and according to these four types of features, they listed the industrial landscape design elements as an important criterion and element of the POE.

### *2.4. Renovation of Shougang Park*

Based on the above, all the elements inside the four characteristics are summarized, and the final evaluation index results are simplified after having similar elements. Part A “place-based characteristics” includes surface trace saving and re-creation, protection of facilities and buildings related to symbolism, recycling of waste facilities into park facilities, converting waste into park design elements, and reflecting on the history and culture of the park by holding events (these 5 evaluation indicators); Part B “natural environment characteristics” includes the harmonious natural landscape, environmental regeneration of damaged or neglected areas, plant diversity, contaminated water purification, and natural area connectivity (these 5 evaluation indicators); Part C “usability characteristics” includes easy access, an activity area, easy navigation in the park, information facilities, convenient facilities, cultural facilities, sports facilities, and lighting (these 8 evaluation indicators); Part D “management characteristics” includes hygiene and cleanliness, security, facility maintenance, equipment maintenance, and industrial heritage maintenance (these 5 evaluation indicators).

## **3. Methods**

### *3.1. Research Scope*

As the imperial capital of the Ming and Qing dynasties and the capital of New China, Beijing’s urban economic development was mainly supported by consumption, and its modern industrial base was rather weak compared to the important cities of early modern Chinese industry (e.g., Shanghai, Tianjin, Shenyang, etc.). However, after the founding of New China, the goal of transforming Beijing from a consumer city to a production city was set, and subsequently, Beijing vigorously developed its heavy industries and quickly became an important industrial base, leading the country in areas such as cotton spinning, electronics, and steel [39]. For the sustainable development of Beijing and the success of the 2008 Olympic Games, Shougang Group decided to stop production and move out of the city. In Beijing’s “two-axes–two-belts–multi-center” urban spatial structure, Shougang is at the node where the western development belt and the east–west cultural axis intersect, which has an important role and significance. Shougang Park shoulders the important task of becoming a landmark of urban rejuvenation; Figure 1 shows the location of Shougang Park in Beijing and the plan of the park, six locations are labeled,

and we, through the information and actual research, chose these six locations and took pictures to show the image of Shougang Park (Figure 2). The six images in Figure 2 are the following: 1, three blast furnaces; 2, Qunming Lake; 3, industrial retrofitting of dry dust collection tanks; 4, Xiuchi Lake; 5, the Winter Olympic Ski Jump; and 6, the Beijing Winter Olympics Organizing Committee office area based on the transformation of industrial heritage, which perfectly demonstrate the results of the transformation of Shougang Park's industrial heritage and the environmental landscape. The three blast furnaces are the most representative industrial relics in Shougang Park, which have strong aged value and historical value, enabling people to recall the years of the machine industry era and generate unique emotions. Qunming Lake and Xiuchi Lake promote the transformation of the cultural content of Shougang Park's industrial development, transforming Shougang Park from the initial "technical" path to the "humanistic" path, and adding water bodies in the industrial park to revitalize the park's ecological landscape, which made Shougang Park greener and more modern at that time. The industrial transformation of the dry dust collection tank (image 3) has strong industrial aesthetic characteristics and demonstrates the design idea of blending the old and the new. In 2016, Shougang was selected as the office of the Winter Olympics Organizing Committee (image 5) and the venue of the snowboarding big jump event, its name called Big Air Shougang (image 6); the Winter Olympics accelerated the process of renewing and transforming the northern district of Shougang, and the built environment of the two sites made the transformation of Shougang Park's industrial heritage more urbanized and able to fully represent Shougang Park. These six sites are representative of the overall landscape of Shougang Park, and have strong typicality and representativeness.

With continuous and in-depth development of the protection and reuse of industrial heritage, coupled with the intervention of the Beijing Winter Olympic Games, Shougang Park is more perfected and moves towards the ambitious goal of a high-end industrial service zone, traditional industrial green transformation zone, and post-industrial cultural and sports innovation base, which will become an importance-based industrial heritage transformation park. Therefore, Beijing Shougang Park is a typical example of industrial heritage transformation and has a great demonstration effect on the heritage transformation of other regions in China.

### *3.2. Research Questions and Survey Methods*

From the point of view of space users, the study needed to get to know the behavior of users of the park. For this purpose, we designed some questions for the information of users, including their gender, age, education level, and place of work and residence. The general user behavior includes the transportation to the park, arrival time, frequency of visits to the park, seasonal use, day of the week, reason for the visit, accompanying visit, main areas and functions used in the park, etc. For this purpose, we designed a questionnaire, which includes several evaluation items about the planning and design of the park, mainly from the four characteristics summarized; at the end of the questionnaire, we set the overall evaluation of the park, including overall satisfaction and intention to revisit and recommend. The general information and usage behavior of the users are statistically based on frequency statistics, and 23 evaluation items in the four characteristics are quantified in the form of a five-point Richter scale, and a copy of the questionnaire is provided (Figure A1).

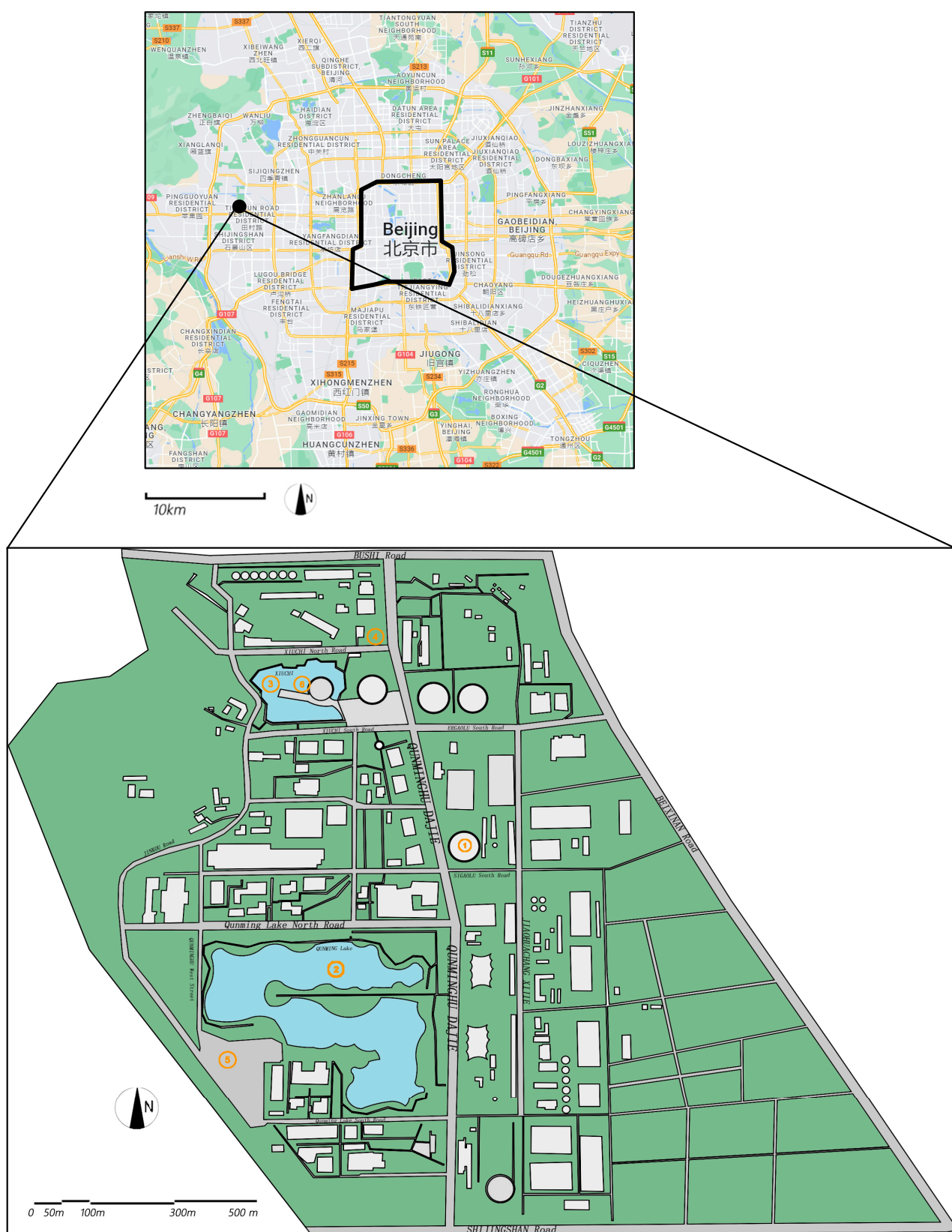


Figure 1. Location map and floor plan of Shougang Park.





image1

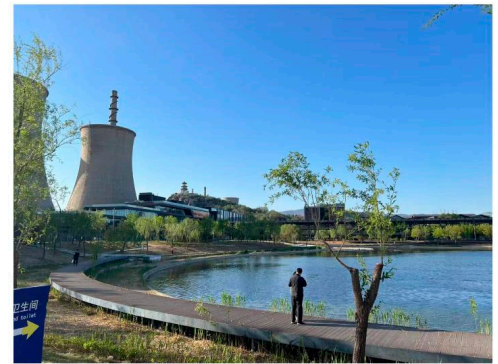


image2



image3

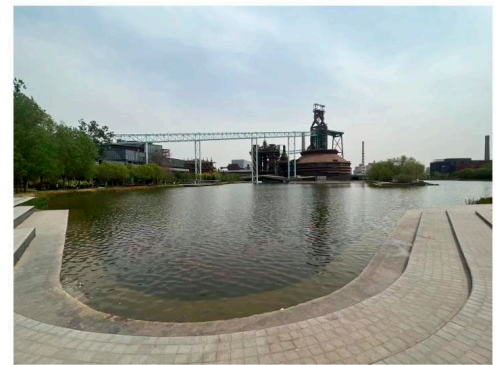


image4



image5



image6

**Figure 2.** Six typical attractions in Shougang Park.

The designed questionnaires were randomly distributed offline in the north area of Shougang Park, and 30 questionnaires were distributed in Shougang Park in advance to ensure the feasibility of the questionnaires, and the 30 questionnaires were collected and statistically tested for reliability, and the below results were obtained, showing that regarding the reliability analysis of the design element evaluation items in Shougang Park based on industrial heritage renovation, all alpha values were above 0.8, which shows that the evaluation factors were set with high internal consistency (Table 1). After the preliminary test, the questions set in the questionnaire were modified and supplemented, and the questionnaire was distributed again, and a total of 134 valid samples were collected, and the analysis was launched through the questionnaire data.

**Table 1.** Data reliability values of the 30 questionnaires about Shougang Park.

Content	Projects	Alpha Value	Number of Questions
Industrial heritage park for brownfield reuse	Importance	0.876	23
	Satisfaction	0.923	23
	Overall evaluation	0.831	3

### 3.3. Data Analysis Methods

The questionnaire data were imported into an SPSS 24.0 statistical application, and the designed questions were subjected to a frequency analysis, reliability analysis, IPA analysis, *t*-test, ANOVA, and multiple regression analysis.

(1) A reliability analysis was used to determine the degree of internal consistency of the respective levels of satisfaction importance of park design elements. Then, satisfaction and importance were quantified using the derived design elements with a five-point Likert scale. (2) The demographic characteristics and usage behavior data of Shougang Park users were counted and compiled through the frequency analysis. (3) The relationship between satisfaction and importance of design elements in the park was revealed through the IPA analysis. (4) Based on the ANOVA, demographic and user behavior data were used to test whether there were differences in their satisfaction with the design elements. (5) A multiple regression analysis was used to verify the relationship between the independent satisfaction variables of the park design elements and users' behavioral intentions.

## 4. Results

### 4.1. Data Analysis about Demographic Statistics and User Behavior Characteristics

We summarized the questionnaire data to produce a data analysis about demographic characteristics and user behavioral characteristics.

- (1) In terms of gender, the number in the male population is slightly higher than that in the female population (Table 2).
- (2) In terms of age, the age group of the park users is mostly concentrated in the age range of 18 to 25 and 30 to 40, indicating that the main users of the park are young people and adults.
- (3) In terms of occupation, the highest percentage of users are from enterprises, followed by professional technicians and state officials.
- (4) In terms of education level, bachelor's and master's degrees account for the highest percentage, and the users of the park are highly educated people.
- (5) In terms of residence, Shijingshan District in Beijing has the highest percentage of users, followed by Haidian District and Dongcheng District.
- (6) In terms of transportation, users use private cars the most, followed by walking and cabs.
- (7) The most users arrive at the park in 10 min to 30 min.
- (8) In terms of visit frequency, once a year is the most common visit frequency, followed by once a day (Table 3).
- (9) On the day of use, most users visit Shougang Park regardless of the day, followed by most people visiting the park on weekends.
- (10) In terms of stay time, most users choose to stay in the park for 1–2 h.
- (11) In terms of usage time, most users do not choose a specific time period to visit the park, and their visit time is random.
- (12) In the item of follow-up visits, the option with the highest percentage is visiting the park with friends.
- (13) The common spaces in the park are natural space areas; people prefer nature in the industrial landscape, and the main purpose of use in the park is leisure walking (Figure 3).
- (14) The main use facility in the park is the sports square, followed by the industrial heritage three blast furnaces and Big Air Shougang.

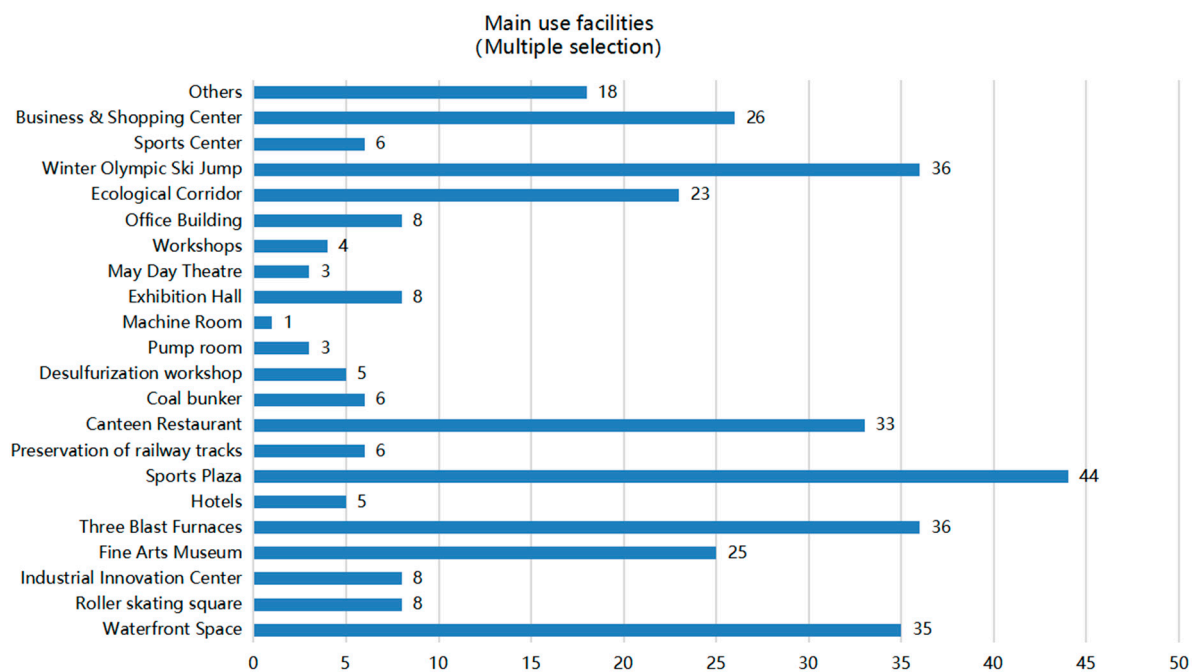
- (15) The most satisfying place for users in the park is the existing industrial heritage, followed by the ecological landscape; the least satisfying is the lack of recreational facilities and amusement programs (Table 4).

**Table 2.** User information summary.

Type	Content	Frequency	Percentage
Gender	Male	72	53.7%
	Female	62	46.3%
Age	Under 18	16	11.9%
	18–25	29	21.6%
	26–30	26	19.4%
	31–40	33	24.6%
	41–50	14	10.4%
	51–60	8	5.9%
	More than 60	12	8.9%
Educational level	Below high school	20	14.9%
	High school	20	13.4%
	Bachelor's	57	42.5%
	Master's	28	20.9%
	PhD	3	2.2%
	Others	6	4.4%
Job	Student	30	20.8%
	Private enterprise personnel	17	12.7%
	Stated-owned enterprise personnel	15	11.2%
	Civil servant	9	6.7%
	Salesperson	4	2.9%
	Housewife	4	2.9%
	Freelancer	11	8.2%
	R&D personnel	4	2.9%
	Artist	1	0.74%
	Professor	2	1.5%
	Teacher	7	5.2%
	Professional	10	7.5%
	Retiree	6	4.4%
	Others	15	11.2%
Residence	Dongcheng area	16	11.9%
	Xicheng area	4	3%
	Haidian area	20	14.9%
	Chaoyang area	10	7.5%
	Shijingshan area	50	37.3%
	Tongzhou area	5	3.7%
	Fengtai area	12	8.9%
	Beijing suburbs	11	8.2%
	Outside of Beijing	6	4.4%

**Table 3.** User behavior characteristic information summary.

Type	Content	Frequency	Percentage
Transportation	Walk	20	14.9%
	Bus	18	13.4%
	Subway	18	13.4%
	Private car	45	33.6%
	Taxi	19	14.2%
	Jogging	6	4.4%
	Bike	8	6%
Time of arrival	Less than 10 min	15	11.2%
	10 to 30 min	52	38.8%
	30 min to 1 h	42	31.3%
	1 h to 2 h	19	14.2%
	More than 2 h	6	4.4%
How often	Everyday	25	18.6%
	Every 2 or 3 days	11	8.2%
	Once a week	22	16.4%
	Once a month	24	17.9%
	Once an annual quarter	16	11.9%
	Once a year	36	26.7%
What day	Ordinary day	29	21.6%
	Weekend	39	29.1%
	Public vacation	7	5.2%
	No matter what day	59	44%
Dwell time	10–30 min	6	4.4%
	30 min–1 h	26	19.4%
	1–2 h	52	38.8%
	More than 2 h	50	37.3%
Usage time	Morning	8	6%
	Nine to eleven o'clock	13	9.7%
	Lunch time	14	10.4%
	Fourteen o'clock to fifteen o'clock	29	21.6%
	Dinner time	6	4.4%
	Night	4	3%
	Any time period	60	44.8%
Follow up	Alone	24	17.9%
	Friend	34	25.4%
	Couple	8	6%
	Family	28	20.9%
	Colleague	10	7.4%
	Lovers	9	6.7%
	Others	21	15.7%
Most used space	Waterfront area	23	17.2%
	Industrial heritage	39	22.4%
	Natural landscape	50	37.3%
	Green space	22	16.4%



**Figure 3.** Main use facilities regarding demographic characteristics of users related to Shougang Park.

**Table 4.** Users' satisfaction and dissatisfaction with the contents of Shougang Park.

Users Most and Least Satisfied with the Park Type	Content	Frequency	Percentage
Satisfied with Park	Perfect management	8	6%
	Project variety	22	16.4%
	Easy access	25	18.6%
	Ecological landscape	29	21.6%
	Industrial heritage preservation	34	25.4%
	Facility diversity	11	8.2%
	Others	5	3.7%
	Total	134	100%
Unsatisfied with Park	Management deficiencies	3	2.2%
	Lack of projects	31	23.1%
	Difficult to access	5	3.7%
	Lack of security facilities	3	2.2%
	Inadequate related information	15	11.2%
	Lack of review information material	8	6%
	Lack of facilities	32	23.9%
	Others	37	27.6%
	Total	134	100%

#### 4.2. Reliability Analysis

In this study, the reliability of importance and satisfaction of all Shougang Park design elements was analyzed, and the Cronbach alpha values of importance and satisfaction of Shougang Park design elements were all greater than 0.88. After the validation analysis, the reliability of the questionnaire on the importance and satisfaction of design elements is high (Table 5).



**Table 5.** Reliability of questionnaire data importance and satisfaction.

Design Items	Cronbach Alpha for Each Item (Importance)	Cronbach Alpha for Each Item (Satisfaction)
A. Place-based characteristics	0.892	0.884
B. Natural environment features	0.894	0.881
C. Usability features	0.894	0.881
D. Management characteristics	0.893	0.880
E. Overall satisfaction	0.892	0.881

#### 4.3. Descriptive Analysis

Visitors to Shougang Park chose park security as an important factor in designing the industrial heritage park; they chose the preservation and re-creation of surface traces and holding recreational activities in the park as relatively unimportant elements in the design. In terms of satisfaction, the preservation of symbolic facilities and buildings was selected as the most satisfying element of industrial heritage park design. Information facilities were selected as the least satisfactory element of the industrial heritage park design elements (Table 6). Previous research mainly focuses on the analysis of user frequency and satisfaction with the park environment, in order to make the research more in-depth, and detailed personal information and behavioral characteristics of the users can make the industrial transformation design of the specific project have more control in place, and furthermore, the exploration of the park regarding the various types of user satisfaction differences can be more effective in analyzing the park problems and deficiencies, and thus enhance the park's environmental improvement and governance level. Evaluating and analyzing the design of the park through the users' perspective can make the idea of human-centeredness better integrated into industrial heritage renovation and urban renewal. For example, based on the four major categories of industrial heritage renovation and design parks, through the analysis of the users' personal information and behavioral characteristics, the categories a user focuses more on and the corresponding design elements can be concluded, which will provide a better guidance for the park's renovation and upgrading. In turn, this creates positive feedback by improving the environment to enhance user satisfaction, allow nearby residents and tourists to have a better experience in the industrial heritage park, and at the same time provide a good basis for the subsequent renovation of other categories of industrial heritage. Problems and areas for improvement of the park based on the users' perspectives are presented in the following sections.

**Table 6.** Data values of industrial heritage renovation design elements in Shougang Park (importance and satisfaction).

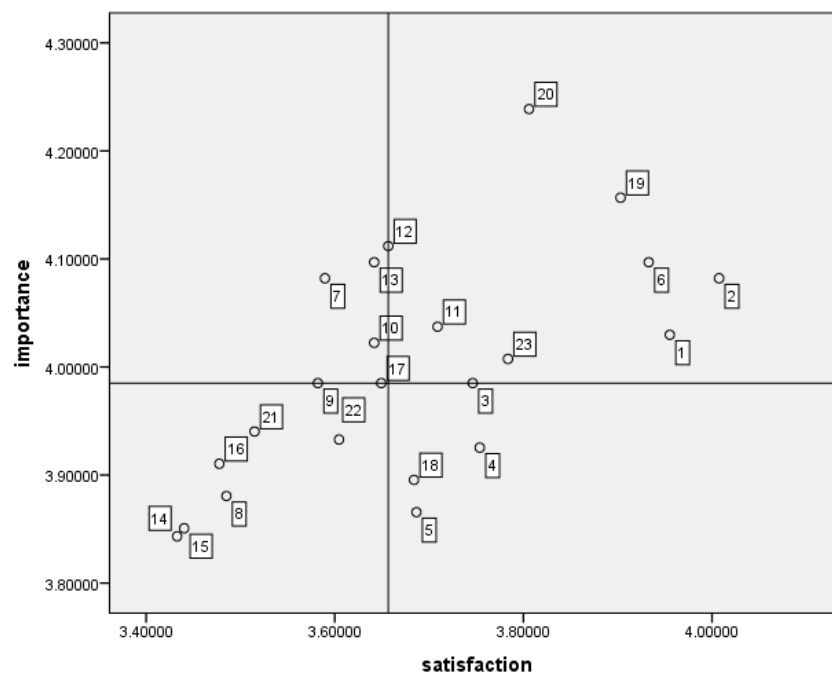
		Design elements	Importance	Grade	Satisfaction	Grade
Based on Industrial Heritage Park Area Design Methodology and Elements	A. Locality Characteristics	a1 Saving and re-creation of surface traces	4.029	9	3.955	2
		a2 Protection of symbolic facilities and buildings	4.082	6	4.007	1
		a3 Recycling of waste facilities into park facilities	3.985	12	3.746	8
		a4 Transforming waste into park design elements	3.925	17	3.753	7
		a5 Reflecting on the history and culture of the park by holding events	3.866	21	3.686	11
	B. Natural Environment Characteristics	b1 Harmonious natural landscape	4.097	5	3.932	3
		b2 Environmental regeneration of damaged or neglected areas	4.082	7	3.589	17
		b3 Plant diversity	3.881	20	3.485	20
		b4 Contaminated water purification	3.985	13	3.582	18
		b5 Natural area connectivity	4.022	10	3.641	14
	C. Usability Features	c1 Easy access	4.037	8	3.709	9
		c2 Activity area	4.112	3	3.657	12
		c3 Easy to navigate in the park	4.097	5	3.641	15
		c4 Information facilities	3.843	23	3.433	23
		c5 Convenient facilities	3.851	22	3.440	22
		c6 Cultural facilities	3.910	18	3.477	21
		c7 Sports facilities	3.985	14	3.649	13
		c8 Lighting	3.895	19	3.694	13
	D. Management Characteristics	d1 Hygiene and cleanliness	4.157	2	3.902	4
		d2 Security	4.239	1	3.806	5
		d3 Facility maintenance	3.940	15	3.515	19
		d4 Equipment maintenance	3.933	16	3.604	16
		d5 Industrial heritage maintenance	4.007	11	3.784	6

#### 4.4. IPA Analysis

We conducted an IPA analysis of the design elements of Shougang Park (Figure 4), in which the environmental regeneration of damaged or neglected areas, natural area connectivity, activity areas, and ease of navigation in the park are four items that are more important to users but less satisfying, and need to be improved as soon as possible.

Design elements related to contaminated water purification, plant diversity, and amenities are less important and less satisfying to users. Preservation and re-creation of surface traces, preservation of symbolic facilities and buildings, harmonious natural landscapes, cleanliness, and safety were more important design elements with higher satisfaction. Recycling waste facilities into park facilities, converting waste into park design elements, and reflecting on the park's history and culture by holding events were considered less important but more satisfying to users. The levels of cultural facilities, equipment maintenance, facility maintenance, and amenities are at low satisfaction levels and should be improved. There is a need to enhance the promotion of the place-based characteristics of industrial sites to increase their importance, such as the conversion of waste facilities into park facilities, integration of industrial elements into industrial design, and display of the industrial history and culture of the park through the organization of events. The numbers in the IPA model analysis in Figure 4 have corresponding evaluation

items, which are 1. Saving and re-creation of surface traces, 2. Protection of symbolic facilities and buildings, 3. Recycling of waste facilities into park facilities, 4. Transforming waste into park design elements, 5. Reflecting on the history and culture of the park by holding events, 6. Harmonious natural landscape, 7. Environmental regeneration of damaged or neglected areas, 8. Plant diversity, 9. Contaminated water purification, 10. Natural area connectivity, 11. Easy access, 12. Activity area, 13. Easy to navigate in the park, 14. Information facilities, 15. Convenient facilities, 16. Cultural facilities, 17. Sports facilities, 18. Lighting, 19. Hygiene and cleanliness, 20. Security, 21. Facility maintenance, 22. Equipment maintenance, and 23. Industry heritage maintenance.



**Figure 4.** IPA analysis data results.

#### 4.5. Differential Analysis of Satisfaction with Design Elements Based on Demographic Characteristics and User Usage Behavior Characteristics

Design factor satisfaction was analysed based on information such as gender, age, occupation, and place of residence. Corresponding methods were adopted according to the different variables, with an independent samples *t*-test for differences between two groups of variables (male and female) and ANOVA for satisfaction with the remaining variables (age, occupation, education, and residence) with three or more group variables. An analysis of variance, abbreviated as ANOVA, refers to the determination of whether the overall mean is equal by using the analysis of variance of multiple samples, and the determination of ANOVA results;  $\sqrt{\quad}$  means there is a significant difference, indicating that there is an influential relationship between the two factors;  $\times$  indicates no significant difference, indicating that there is no influential relationship between the two factors. Satisfaction of Shougang Park users regarding design elements varies by gender, age, transportation, the frequency of use, the time of use, and the purpose and reason for the visit (Tables A1 and A2).

**Place characteristics:** Regarding the characteristics of place-ness, people in Xicheng and Haidian Districts are most satisfied with their design elements, and people outside Beijing are least satisfied. Couples who travel together are satisfied, and those who visit Shougang Park with colleagues are the least satisfied. People who exercise for sport purposes are the most satisfied in user behavior, and workers are the least satisfied.

**Usable characteristics:** In terms of usability design elements, artists are the most satisfied, housewives are the second most satisfied, and technical developers are the least satisfied. Interestingly, the length of time it takes to get to Shougang Park also has a

significant impact on the design elements of the usability features, with those who arrived in the shortest amount of time (less than 10 min) being the most satisfied and those who arrived in the longest amount of time (more than 2 h) being the least satisfied. Those who use Shougang Park most frequently (daily; every 2 days) are the most satisfied with it, and those who use it relatively less frequently (once an annual quarter) are the least satisfied. Those who visit Shougang Park from Monday to Friday are the most satisfied with it, and those who visit Shougang Garden on holidays are the least satisfied. And those who use Shougang Park in the evening are the most satisfied, and those who use it during lunchtime are the least satisfied.

Natural environmental characteristics: People with low education are the most satisfied with the design elements of natural environmental features, while those with master's degrees are the least satisfied. The suburban and local people are the most satisfied with the design elements, while the foreign people are the least satisfied with them. Private car owners are the most satisfied, while those who use cabs and subways are the least satisfied.

Administrative characteristics: In terms of the design elements of management characteristics, the highest satisfaction rate is among those with bachelor's degrees and the lowest satisfaction rate is among those with high school degrees. People who live in Fengtai District are the most satisfied, and people from outside Beijing are the least satisfied. The users who visit on ordinary days are the most satisfied, and those who come on holidays are the least satisfied.

#### 4.6. Analysis of the Influential Relationship between Satisfaction and Overall Satisfaction

The correlation analysis of the three types of satisfaction according to the four types of evaluation items (place-based, natural, practical, and management) was analyzed using a multiple linear regression analysis, and the data were analyzed as follows (Table 7).

**Table 7.** Data on the influential relationship between satisfaction and behavioral intention.

Design Elements	Unstandardized Coefficient		Standardization Factor		t	VIF	R <sup>2</sup>	F
	B	Standard Error	Beta					
Relationship between overall satisfaction and design elements in Shougang Park ( $p = 0.000 < 0.05$ )	Site Characteristics	0.080	0.120	0.069	0.669	1.936	0.532	12.733
	Natural							
	Environmental Characteristics	0.221	0.110	0.186	2.013	1.533		
	Usability Characteristics	0.214	0.136	0.165	1.580	1.972		
	Administrative Characteristics	0.291	0.132	0.234	2.202	2.029		
Relationship between recommended intention and design elements in Shougang Park ( $p = 0.000 < 0.05$ )	Site Characteristics	−0.001	0.141	−0.001	−0.006	1.936	0.461	12.668
	Natural							
	Environmental Characteristics	0.276	0.129	0.207	2.144	1.533		
	Usability Characteristics	0.228	0.159	0.157	1.432	1.972		
	Administrative Characteristics	0.287	0.155	0.205	1.851	2.029		
Relationship between intention to play again and design elements in Shougang Park ( $p = 0.133 > 0.05$ )	Site Characteristics	0.232	0.143	0.168	1.621	1.951	0.193	8.796
	Natural							
	Environmental Characteristics	0.264	0.132	0.185	2.004	2.547		
	Usability Characteristics	0.183	0.162	0.118	1.128	2.426		
	Administrative Characteristics	0.278	0.158	0.187	1.755	1.121		

By analyzing the effect of satisfaction with design elements on the overall satisfaction of Shougang Park, the explanatory power of the regression model is 53.2% and the analysis of the regression equation was statistically significant ( $F = 12.733$ ,  $p < 0.01$ ). The VIF values of all independent variables are less than 10, so it could be judged that there was no problem of multicollinearity. For each independent variable, natural environment characteristics ( $\beta = 0.186$ ,  $p < 0.05$ ) and management characteristics ( $\beta = 0.234$ ,  $p < 0.05$ ) had a significant positive effect (+) on the overall satisfaction of Shougang Park. That is, natural environment characteristics and management characteristics have a greater impact on the overall satisfaction of Shougang Park. The results of the analysis of the effect of satisfaction with the design elements of Shougang Park on revisiting were found to have no statistical effect ( $p > 0.01$ ).

By analyzing the effect of satisfaction with design elements on the recommendation intention of Shougang Park, the explanatory power of the regression model is 46.1% and the regression equation analysis is statistically significant ( $F = 12.668$ ,  $p < 0.01$ ). The VIF values of all independent variables are less than 10, so it could be judged that there is no problem of multicollinearity. For each independent variable, natural environment characteristics ( $\beta = 0.185$ ,  $p < 0.05$ ) have a significant positive effect (+) on the recommendation intention of Shougang Park. That is, natural environment characteristics have a greater effect on the Shougang Park recommendation intention.

#### 4.7. Problems and Improvement Measures

According to the content of the questionnaire and in-depth interviews, the main issue that needs to be addressed in the park is the design of information facilities, convenience facilities, and cultural facilities. First of all, North Shougang Park is a large park, and based on the human scale at the walking level, this makes the distance of each area farther, and information navigation becomes very important; according to the understanding of the park users, they think that the information navigation facilities in Shougang Park are relatively small, and it is recommended to increase the navigation facilities in the park.

Even though there are several toilets in the park, users think that the number of toilets should be increased and obvious instructions should be added to facilitate users' needs. According to the location of the existing toilets in the park, new toilets should be added at traffic nodes and remote areas of the park to enhance users' convenience experience in the park. Many users think that there is a lack of introduction of cultural facilities in the park and a lack of corresponding understanding of the renovation design of industrial heritage. A certain explanation of the renovation design of industrial heritage in the park should be given, which can enhance people's awareness and understanding of industrial heritage and also contribute to improve the image and status of industrial heritage among users, which will contribute to the long-term development of Shougang Park.

## 5. Discussion

Based on the transformation of industrial heritage, Shougang Park has played an active role in urban regeneration by coordinating the economic, cultural, and environmental aspects of the urban area. A user-based post-occupancy evaluation of Shougang Park will contribute to the management of the subsequent development of the park, the maintenance of the project, and the improvement in the design level. China's industrial heritage renovation started relatively late, and the research content of industrial heritage renovation is mostly focused on the design and renewal strategy of heritage renovation and case studies, but relatively little is on the renewal evaluation of industrial heritage renovation parks, and the POE mostly focuses on the frequency analysis of user satisfaction, and relatively little is on the correlation analysis of evaluation factors and the influence of multiple factors on evaluation factors. This study uses a representative case, Beijing Shougang Park, to conduct a POE study. A statistical analysis was conducted based on the results of user questionnaires, including a frequency analysis of design elements, importance and satisfaction model analysis, analysis of variance, and multiple regression



analysis, combined with in-depth interviews. Finally, a more comprehensive analysis of the park was conducted, and recommendations for park improvement were made based on the results of the analysis.

## 6. Conclusions

By analyzing the POE of Beijing Shougang Park, a typical example of the adaptive reuse of industrial heritage in China, this study presents the current problems of the park and gives suggestions for improvement and development. This study also aims to provide relevant elements to be considered in the planning and design of industrial-heritage-based parks. The conclusions of this study are summarized as follows:

Firstly, the design elements for the renovation of industrial heritage in the steelmaking category are classified and summarized based on the literature reading, and these evaluation factors are grouped into four categories: place-based characterization of industrial heritage, natural environment characteristics, practical characteristics, and administrative characteristics. Secondly, the main users of Shougang Park are in the age range of 31–40 years old. The highest usage rate of the sports plaza as a park facility is followed by the industrial heritage three blast furnaces, compared to the lowest usage rate of the machine room, which is also industrial heritage. Third, the analysis of industrial park renovation design shows that although the importance of Shougang Park for design elements is generally focused on practical features and management and maintenance features, in comparison, industrial site features and natural environment features are less important than the first two and do not receive much attention from users. Fourthly, through the IPA analysis, the following urgent problems of Shougang Park were found: environmental regeneration of damaged or neglected areas in industrial site characteristics; natural area connectivity in natural environment characteristics; navigation to guide in the park in practical characteristics; cultural facilities, convenience facilities, and activity areas need to be improved as soon as possible; and equipment maintenance and facility maintenance in management characteristics. Fifth, by analyzing the satisfaction of design elements with user demographic characteristics, the variability of satisfaction of design elements was found in Shougang Park, which varied mainly according to the factors of work, education level, and residence. Sixth, there is the analysis about the influential relationship between the satisfaction of design elements and the characteristics of usage behaviors. The satisfaction of design elements in Shougang Park is different with the factors of the transportation mode, frequency of use, time of use, daily use, follow-up visit, and reason for the visit. Seventh, there is the analysis about the influence of design elements on the variability of overall satisfaction, and the natural environment characteristics and management and maintenance characteristics have a significant influence on the overall satisfaction of Shougang Park; the natural environment characteristics have a significant positive influence on the recommendation intention of Shougang Park.

The urban industrial heritage represents the industrial civilization of the city, and the previous usage behavior of people in the park during the industrial economic development translates to people's unique emotional memories and special environmental cognition of the park place now. The design of industrial heritage renovation should not only ensure the industrial place and industrial spirit characteristics but also focus on developing the natural landscape part of the park, such as enriching the number and types of vegetation in the industrial park, the harmony between the industrial natural landscape and industrial remains, the protection and reuse of industrial relics, and the organic combination with nature, which are very important, and focus on the protection and renovation of the original ecological environment of industrial heritage [40]; at the city level, the industrial landscape design and planning of industrial parks should highlight the humanistic characteristics and play an active role in the green infrastructure of the city as far as possible. An open park space will meet the diversified needs of urban people, so it is necessary to effectively improve the connectivity of the park area space and effectively link the multi-dimensional characteristics of renovated industrial parks. An important factor regarding the user per-

ception of industrial heritage parks is safety, and the parks that contain gazetted attributes can be renovated and subsequently renewed to enhance environmental safety by taking into account certain rules based on crime prevention, which can be realized through the introduction of the CPTED (Crime Prevention Through Environmental Design) concept [41] into the design. The CPTED concept is the proper design and effective use of a built environment, which can lead to a reduction in the incidence of crime and fear of crime as well as to improvement in the quality of life. The utility feature project and the post-management and maintenance feature project of the park indicate that the development of Shougang Park will be deeply integrated with the basic transportation at the city level, the urban road network pattern will be more perfect, the bearing capacity of urban infrastructure will be strengthened, and the development of the park and urban construction will promote each other and develop together. The subsequent maintenance of the park should also follow the pace of social development, which is a dynamic process that requires constant adjustment. Public participation can contribute to solve the problems of the insufficient investment and low quality of visitors in the management and maintenance of Chinese parks [42]; the improved quality of the post-management of parks also helps to enhance public awareness of environmental protection and promote sustainable urban development.

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**Institutional Review Board Statement:** Ethical review and approval were waived for this study, due to involving no more than minimal risk.

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** The data are unavailable due to privacy or ethical restrictions.

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**Conflicts of Interest:** The authors declare no conflict of interest.

## Appendix A

Questionnaire on the use of Beijing Shougang Park	
<p>Thank you very much for taking the time to do a questionnaire!</p> <p>With the rapid development of urban construction, industrial heritage-based urban cultural parks have played an active role in shaping the city's image, regional economic development and environmental improvement, as well as the continuation of the history of the city's waterfront.</p> <p>Beijing Shougang Park is a representative example of industrial heritage parks, we hope that you can be based on the daily use of the park to come up with a certain evaluation and feedback, your comments on the park's upgrading and optimization and renovation of the park will have a positive effect and an important impact, thank you!</p>  <p>I. Personal User Information:</p> <p>1.Your gender: Male<input type="checkbox"/>; Female<input type="checkbox"/></p> <p>2.Your age group: Under 18<input type="checkbox"/>; 18–25<input type="checkbox"/>; 26–30<input type="checkbox"/>; 31–40<input type="checkbox"/>; 41–50<input type="checkbox"/>; 51–60<input type="checkbox"/>; over 60 <input type="checkbox"/></p> <p>3.Your current occupation: Students <input type="checkbox"/>; Private sector workers <input type="checkbox"/>; State workers <input type="checkbox"/>; Sales workers <input type="checkbox"/>; Housewives <input type="checkbox"/>; Freelancers <input type="checkbox"/>; Technical/R&amp;D workers <input type="checkbox"/>; Artists <input type="checkbox"/>; Professors <input type="checkbox"/>; Professionals (e.g., accountants, lawyers, architects, healthcare professionals, etc., journalists, etc.) <input type="checkbox"/>; Retirees <input type="checkbox"/>; Teachers <input type="checkbox"/>; Other <input type="checkbox"/></p> <p>4.Your education: Less than high school student<input type="checkbox"/>; High school graduate<input type="checkbox"/>; Bachelor's degree<input type="checkbox"/>; Master's degree<input type="checkbox"/>; Doctorate degree<input type="checkbox"/>; Other<input type="checkbox"/></p> <p>5.Place of residence: Dongcheng District <input type="checkbox"/>; Xicheng District <input type="checkbox"/>; Haidian District <input type="checkbox"/>; Chaoyang District <input type="checkbox"/>; Shijingshan District <input type="checkbox"/>; Tongzhou District <input type="checkbox"/>; Fengtai District <input type="checkbox"/>; Beijing Suburbs <input type="checkbox"/>; Outer Beijing<input type="checkbox"/></p>	<p>II.User usage behavior:</p> <p>1. Arrival Transportation. Walk<input type="checkbox"/>; Bus<input type="checkbox"/>; Subway<input type="checkbox"/>; Private car<input type="checkbox"/>; Taxi<input type="checkbox"/>; Bicycle<input type="checkbox"/>.</p> <p>2.Arrival time: Less than 10 minutes<input type="checkbox"/>; 10 to 30 minutes<input type="checkbox"/>; 30 minutes to 1 hour<input type="checkbox"/>; 1 hour to 2 hours<input type="checkbox"/>; more than 2 hours<input type="checkbox"/></p> <p>3.How often: Every day<input type="checkbox"/>; Every two or three days<input type="checkbox"/>; Once a week<input type="checkbox"/>; Once a month<input type="checkbox"/>; Once a season<input type="checkbox"/>; Once a year<input type="checkbox"/></p> <p>4. Use by day: Ordinary days<input type="checkbox"/>; weekends<input type="checkbox"/>; public holidays<input type="checkbox"/>; whatever day<input type="checkbox"/></p> <p>5.Length of stay: 10 minutes to 30 minutes<input type="checkbox"/>; 30 minutes to 1 hour<input type="checkbox"/>; 1 hour to 2 hours<input type="checkbox"/>; more than 2 hours<input type="checkbox"/></p> <p>6.1. Time of use: Morning<input type="checkbox"/>; AM<input type="checkbox"/>; Lunchtime<input type="checkbox"/>; PM<input type="checkbox"/>; Dinnertime<input type="checkbox"/>; Evening<input type="checkbox"/>; Anytime<input type="checkbox"/></p> <p>7. Follow-up: Alone<input type="checkbox"/>; Friends<input type="checkbox"/>; Couples<input type="checkbox"/>; Family<input type="checkbox"/>; Colleagues<input type="checkbox"/>; Couples<input type="checkbox"/>; Other<input type="checkbox"/></p> <p>8.purpose of use: Walking <input type="checkbox"/>; Exercise &amp; Sports <input type="checkbox"/>; Leisure <input type="checkbox"/>; Office <input type="checkbox"/>; Attending Events <input type="checkbox"/>; Attending Meetings<input type="checkbox"/>; Attending Studies<input type="checkbox"/>; Enjoying Nature Participate in events<input type="checkbox"/>; Participate in meetings<input type="checkbox"/>; Participate in studies<input type="checkbox"/>; Enjoy nature<input type="checkbox"/>; Go on a date<input type="checkbox"/>; Other<input type="checkbox"/></p> <p>9.Main Use Facilities (Multiple Choice): Waterfront space (Xiu Pond and Gunnei Lake)<input type="checkbox"/>; Industrial Innovation Center<input type="checkbox"/>; Art gallery <input type="checkbox"/>; Big Blast Furnace (No. 1, 2, and 3)<input type="checkbox"/>; Hotel <input type="checkbox"/>; Sports Plaza <input type="checkbox"/>; Recreation Plaza <input type="checkbox"/>; Retained Railroad Tracks <input type="checkbox"/>; Cafeteria &amp; Dining Room <input type="checkbox"/>; Coal Silos <input type="checkbox"/>; Desulphurization Workshop<input type="checkbox"/>; Plant Rooms<input type="checkbox"/>; Exhibition Halls<input type="checkbox"/>; May Day Theater <input type="checkbox"/>; Workshop <input type="checkbox"/>; Office Building <input type="checkbox"/>; Skywalk (Eco-Highline)<input type="checkbox"/>; Winter Olympic Ski Jump <input type="checkbox"/>; Sports Center <input type="checkbox"/>; Six Workshops (Commercial &amp; Shopping) <input type="checkbox"/>; Others <input type="checkbox"/>; Sports Center <input type="checkbox"/>; Rokugonghui (commercial and shopping) <input type="checkbox"/>; Other <input type="checkbox"/></p> <p>10. Most used spaces: Lake areas<input type="checkbox"/>; Industrial heritage<input type="checkbox"/>; Natural landscapes<input type="checkbox"/>; Green spaces<input type="checkbox"/></p> <p>11. The most satisfying part of the park: Well managed<input type="checkbox"/>; Rich program<input type="checkbox"/>; Easy to access<input type="checkbox"/>; Ecological landscape<input type="checkbox"/>; Preservation of industrial heritage<input type="checkbox"/>; Diversity of facilities<input type="checkbox"/>; Other<input type="checkbox"/></p> <p>12.Least satisfied part: Park management<input type="checkbox"/>; Lack of programs<input type="checkbox"/>; Difficulty in accessing<input type="checkbox"/>; Lack of security<input type="checkbox"/>; Inadequate information related to the area<input type="checkbox"/>; Lack of review materials for the park<input type="checkbox"/>; Lack of facilities Other<input type="checkbox"/>; Lack of facilities</p>
<p>III. Design techniques and elements of Shougang Park</p> <p>A.Locality.</p> <p>1. Conservation and reconstruction of surface traces: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>2. About symbolic facilities and buildings: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>3. Recycling of waste facilities into park facilities: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>4. Transforming waste into park design elements: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>5. Responding to the culture of the park by organizing events: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>B.Natural Environment:</p> <p>1. Harmonized natural landscape: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>2.Environmental regeneration of damaged or neglected areas: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>3.Plant diversity: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>4.Relating to the purification of contaminated water: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>5.Natural area connectivity: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>C.Usability:</p> <p>1.Easy access: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>2.project area: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>3.Easy to navigate in the parks: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p>	<p>4.Information facilities: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>5.Amenities: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>6.Cultural facilities: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>7.Landscape: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>8.Lighting: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>D.manageability:</p> <p>1. Hygienic and clean: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>2.Security: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>3.Facility maintenance: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>4. Equipment maintenance: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>5.Industrial heritage maintenance: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>IV.Synthesis of judgments:</p> <p>1.Overall satisfaction: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>2.Intention to play again: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p> <p>3.Intention to recommend: Importance: Very unimportant<input type="checkbox"/> Unimportant<input type="checkbox"/> Average<input type="checkbox"/> Important<input type="checkbox"/> Very important<input type="checkbox"/> Satisfaction: Very dissatisfied<input type="checkbox"/> Dissatisfied<input type="checkbox"/> Average<input type="checkbox"/> Satisfied<input type="checkbox"/> Very Satisfied<input type="checkbox"/></p>

Figure A1. Copy of questionnaire.

**Table A1.** Analysis of differences in satisfaction with design elements based on demographic characteristics.

	Item	Mean Square	Significance Probability	Satisfaction Difference								
Differences in satisfaction according to the demographic characteristics (Shougang Park)	Sex	0.074	0.508	×								
	Age	0.671	0.0686	×								
	Job	0.222	0.0393	✓								
	Educational Level	0.110	0.0431	✓								
	Residence	0.204	0.0236	✓								
Differences in satisfaction according to job	Variable	student	state staff	functionary	private staff	salesperson	housewife	freelance person	F	satisfaction difference		
	Usable characteristics	3.65	3.50	4.00	3.50	4.00	4.67	3.62	2.298	0.011		
	Variable	technician	artist	professor	professional	retiree	educator	others	F	satisfaction difference		
	Usable characteristics	3.25	5.00	—	3.56	3.33	4.13	3.40	2.298	0.011		
Differences in satisfaction according to educational level	Variable	below high school students	high school graduates	bachelor's	master's	doctor	others	F	satisfaction difference			
	Natural characteristics	4.05	3.79	3.55	3.20	3.67	3.50	3.223	0.009			
	Administrative characteristics	3.55	3.32	3.84	3.37	3.67	3.67	2.777	0.020			
Differences in satisfaction according to residence level (district)	Variable	Dongcheng	Xicheng	Haidian	Chaoyang	Shijing shan	Tong zhou	Fengtai	Beijing suburbs	Outside Beijing	F	Satisfaction difference
	Site characteristics	3.94	4.20	4.14	3.90	4.00	3.75	3.91	4.00	3.00	2.193	0.032
	Natural environmental characteristics	3.88	3.80	3.90	4.00	4.06	3.75	3.64	4.27	3.17	2.092	0.041
	Administrative characteristics	3.88	4.00	3.90	3.80	3.82	3.50	4.09	3.45	2.83	2.353	0.022

**Table A2.** Differential analysis of satisfaction with design elements based on user behavior characteristics.

Differences in satisfaction using user behavior	Item	Mean square	Significance probability		Satisfaction difference								
	Transportation	0.394	0.022		✓								
	Arrival time	0.111	0.054		×								
	Frequency of use	0.416	0.021		✓								
	Use with time	0.732	0.048		✓								
	Daily usage	0.208	0.018		✓								
	Stay time	0.794	0.106		×								
	Visiting followers	0.866	0.018		✓								
Reason for visit	0.032	0.049		✓									
Differences in satisfaction according to the arrival time	Variable	Less than 10 min	10 min–30 min		30 min–60 min		1 h–2 h	More than 2 h	F	Satisfaction difference			
	Usability characteristics	3.67	3.75		3.74		3.40	2.80	2.336	0.059			
Differences in satisfaction according to frequency of use	Variable	Everyday	Once every 2 days		Once every week		Once a month	Once a season	Once a year	F	Satisfaction difference		
	Usability characteristics	4.412	4.410		3.50		3.64	3.38	3.44	3.327	0.009		
Differences in satisfaction according to usage day	Variable	Normal days	Weekend	Vacation	Regardless of the day	F	Satisfaction difference						
	Usability characteristics	3.93	3.36	3.50	3.73	2.954	0.035						
	Administrative characteristics	4.00	3.72	3.00	4.07	5.522	0.001						
Differences in satisfaction according to use with time	Variable	Early morning	Forenoon	Lunch time	Afternoon	Dinner time	Night	Anytime period	F	Satisfaction difference			
	Usability characteristics	3.44	3.71	3.00	3.56	3.14	4.50	3.51	2.260	0.042			
	Administrative characteristics	4.11	4.00	4.07	3.52	4.29	4.50	3.92	2.167	0.050			
Differences in satisfaction according to use with company	Variable	alone	friends	spouse	family	colleague	lover	others	F	satisfaction difference			
	Location characteristics	3.50	3.88	3.82	3.78	3.11	4.11	3.90	2.227	0.040			
	Administrative characteristics	3.67	3.82	3.45	3.56	2.89	3.89	3.52	2.665	0.018			
Differences in satisfaction according to aim of visit	Variable	walk	exercise	rest	office work	partake in activity	meeting	studying	enjoy nature	assignation	others	F	satisfaction difference
	Location characteristics	3.89	4.15	3.84	3.28	3.86	4.00	4.10	3.0	3.20	3.82	2.779	0.005



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