

Evaluation of Public Spaces Attractiveness and Its Influencing Factors in Urban Industrial Parks: A Case Study of Suzhou Industrial Park

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Abstract: High-quality public spaces in industrial parks play an important role in enhancing the environmental image of the parks, employee well-being, and talent attraction. However, research on the factors influencing the attractiveness of public spaces in industrial parks remains relatively limited. Taking three typical industrial parks in Suzhou Industrial Park as the study objects, this study employs big data and GIS analyses, questionnaire surveys, and other methods to construct a public space attractiveness evaluation system comprising three dimensions: physical characteristics, environmental perception, and sense of place, thereby revealing generalizable characteristics and patterns across the parks. The results show that the physical characteristics dimension makes a relatively substantial contribution to attractiveness values, whereas sense of place and environmental perception play reinforcing and supplementary roles, respectively. The physical characteristics dimension carries a relatively high weight, but functional diversity, landmark level, and vitality perform poorly and are key factors requiring improvement. The place meaning indicator makes a relatively high contribution and constitutes an advantageous factor of public spaces. Comfort, aesthetic quality, and place identity make moderate contributions and are potential optimization factors. Activity support and interest also show moderate performance and represent important directions for improvement, among which the provision of functional facilities and the creation of a cultural atmosphere are priority needs for enhancing public space attractiveness. This study can provide a reference for the optimization and high-quality development of public spaces in industrial parks.

Keywords: Industrial parks public spaces, Attractiveness evaluation, Influencing factors, Suzhou Industrial Park

1. Introduction

Since the concept of "industry-city integration" was proposed in 2011, industrial parks have gradually become core spaces for achieving coordinated industry-city development ^[1]. As an important vehicle for promoting the high-quality development and transformation of industrial parks, public spaces can not only improve employees' outdoor activity experiences and relieve stress, but also foster an innovative atmosphere and attract talent ^[2]. With the acceleration of urbanization, the development of public spaces in industrial parks has shifted toward people-centered, high-quality development, emphasizing mixed functions, recreational experiences, and cultural connotations ^[1]. However, owing to the extensive development practices of the early period, industrial parks still face problems such as homogeneous functional facilities, insufficient vitality, and low environmental quality, which affect their sustainable development. Therefore, enhancing the attractiveness of public spaces has become an important issue in industrial-park development.

In recent years, research on industrial parks in China and abroad has gradually shifted from planning and design toward fields such as the determinants of vitality and environmental psychology. For example, Xu et al. emphasized the harmonious development of people, city, environment, and industry, and proposed strategies for science and technology innovation parks including people-centered development, place-making, and openness and sharing, thereby indicating a direction for innovation in industrial park planning ^[3]. Xiong et al. recorded activity data in the field and analyzed the key elements affecting the vitality of public spaces in industrial parks ^[4]. Ding et al. used physical and virtual indicators to measure the physical and digital vitality of industrial parks, respectively, and examined the relationships between vitality and other influencing factors ^[5]. Other scholars have used emotional geography and social-media

data to analyze the effects of environmental characteristics in Shenzhen industrial parks on employees' emotions^[6]. However, existing studies have mostly focused on single dimensions such as spatial vitality, environmental characteristics, or user emotions. Systematic analyses of the key factors that enhance public space attractiveness in industrial parks and their mechanisms remain insufficiently thorough and cannot effectively support quality creation and optimization upgrading of public spaces in the parks. Therefore, taking Suzhou Industrial Park as a case, this study combines big-data and GIS analyses with field questionnaire surveys to obtain indicator data and investigate the core factors influencing the attractiveness of public spaces in industrial parks, providing a theoretical reference and practical basis for the high-quality and sustainable development of industrial parks.

2. Study Objects and Methods

2.1. Study Objects

Suzhou Industrial Park was selected as the study area, and the study objects were specifically limited to public spaces within industrial parks, mainly including streets, landscapes, public-service facilities, and squares. Suzhou Industrial Park is an urban functional zone and a typical national economic and technological development zone. As an important intergovernmental cooperation project between China and Singapore, it has been acclaimed as "an important window into China's reform and opening up" and "a successful model of international cooperation," and it has now joined the ranks of world-class high-tech parks developed by the Ministry of Science and Technology^[7]. Based on field investigation and comparison, three representative industrial parks were selected to cover the major industrial types within Suzhou Industrial Park (Figure 1): Suzhou Creative Industry Park, Suhong Road Industrial Park, and Suzhou Nano-tech Industrial Park. These samples reflect both the objective physical conditions of public spaces in the industrial parks within Suzhou Industrial Park and the subjective experiential characteristics of environmental perception and sense of place, and therefore have high research value.

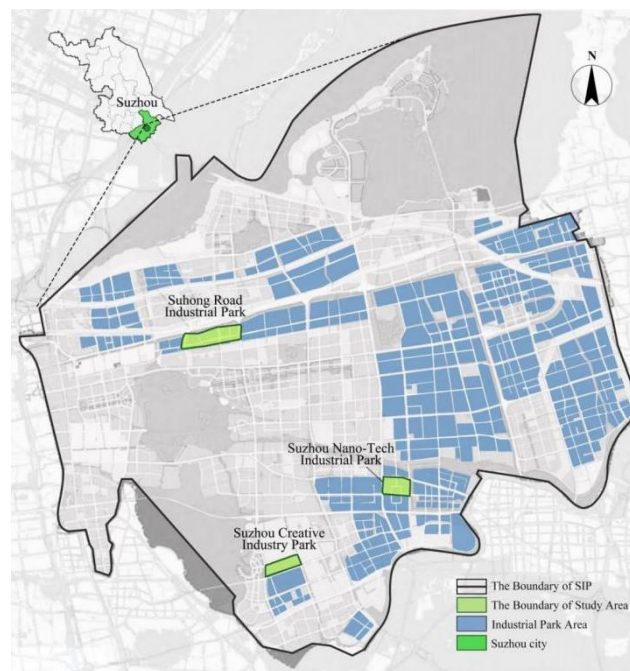


Figure 1: Locations of the study sample areas.

2.2. Evaluation Indicator System

Based on Nasar's integrated framework of environmental psychology^[8] and the characteristics and use of public spaces in the industrial parks within Suzhou Industrial Park, This study constructs a three-dimensional attractiveness evaluation system of physical characteristics, environmental perception, and sense of place (Table 1). This represents a complete pathway from objective spatial attributes to subjective perception and then to affective identification, emphasizing that spatial attractiveness results from the joint effects of physical characteristics and perceptual experience. To a certain extent, the indicator system combines generalizability with contextual adaptability: it can reflect the general

formation mechanism of public space attractiveness in industrial parks and can also be moderately adjusted for specific cases. The details are as follows:

(1) Physical characteristics: These refer to the objective spatial attributes of industrial parks and mainly reflect characteristics such as spatial accessibility, landmark level, and facility provision^[9]. They emphasize spatial 'affordances' and constitute the fundamental conditions for the formation of public space attractiveness.

(2) Environmental perception: This refers to people's perceptual experience of objective spatial elements. It includes not only perceptions of physical characteristics such as spatial form, scale, greenery, and facilities, but also subjective evaluations and emotional responses concerning comprehensive qualities such as environmental comfort and aesthetic quality^[10], which affect people's satisfaction with and preference for the space.

(3) Sense of place: This refers to the emotional attachment formed on the basis of spatial perception. It affects spatial attractiveness and behavioral intentions, reflects the role of public spaces in satisfying employees' needs for emotional belonging and symbolic meaning, and helps enhance employees' sense of self-identity^[11].

Table 1: Evaluation indicator system of Public Spaces Attractiveness in Industrial Parks.

Criterion (B)	Indicator (C)	Indicator Description	Data
Physical characteristics (B1)	Functional diversity (C1)	Level of functional diversity in public spaces within industrial parks	GIS analysis
	Accessibility (C2)	Convenience with which employees can reach public spaces	GIS analysis
	Landmark level (C3)	Level of local landmark level of public spaces in industrial parks	Big data analysis
	Vitality (C4)	Level of participation in activities in public spaces within industrial parks	GIS analysis
Environmental perception (B2)	Comfort (C5)	Employees' subjective evaluation of the overall pleasantness of the environment while using the space	questionnaire
	Esthetic quality (C6)	Employees' overall aesthetic evaluation of public space design, greenery provision, and visual quality	questionnaire
	Activity support (C7)	Employees' subjective perception of the convenience provided by public space facilities and support for activities	questionnaire
	Interest (C8)	Degree of novelty and richness of experience perceived by employees while using the space	questionnaire
Sense of place (B3)	Place identity (C9)	Employees' sense of belonging to public spaces and degree of cultural and identity-based identification	questionnaire
	Place meaning (C10)	Employees' degree of awareness of the symbolic meaning and emotional value carried by public spaces	questionnaire

2.3. Data Collection and Analysis

2.3.1. Physical Characteristic Indicator Data Based on Big Data and GIS Analyses

1) Functional diversity: Based on the open API of Amap, Python 3.4.1 was used to crawl points of interest (POI) for the study area; the data were sourced from OpenStreetMap (OSM) and national geographic information resources. After importing the data into ArcGIS, the study area was divided into 100 m × 100 m grids, and the Shannon-Wiener index was used to calculate the functional diversity of each grid^[12] (Figure 2).

2) Accessibility: Based on POI data for service facilities, a road-network model was constructed using ArcGIS 10.8. According to the design speeds for different road classes: elevated roads and expressways, 80 km/h; arterial roads, 60 km/h; secondary arterial roads, 30 km/h; and local roads, 20 km/h, a spatial impedance model was used to calculate node accessibility^[13] (Figure 3).

3) Landmark level: With reference to previous studies, the number of posts on topics related to urban

landmarks was used to measure landmark level. First, POIs within Suzhou Industrial Park were crawled, cleaned, and screened; post data for related topics on Weibo were then collected, and the number of posts about landmarks in the study area in 2025 was calculated (Table 2).

4) Vitality: Python was used to crawl a total of 36,969 POIs for service facilities such as shops, attractions, and transport facilities in Suzhou Industrial Park. After importing them into ArcGIS, network kernel-density estimation was used to calculate spatial vitality (Figure 4).

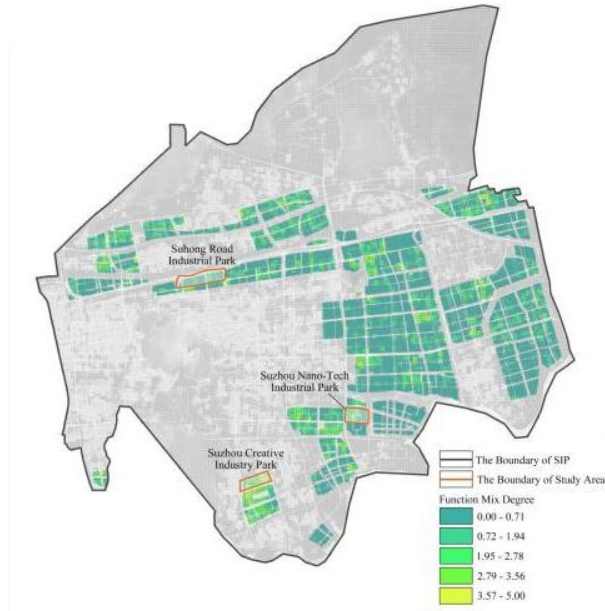


Figure 2: Functional diversity distribution.

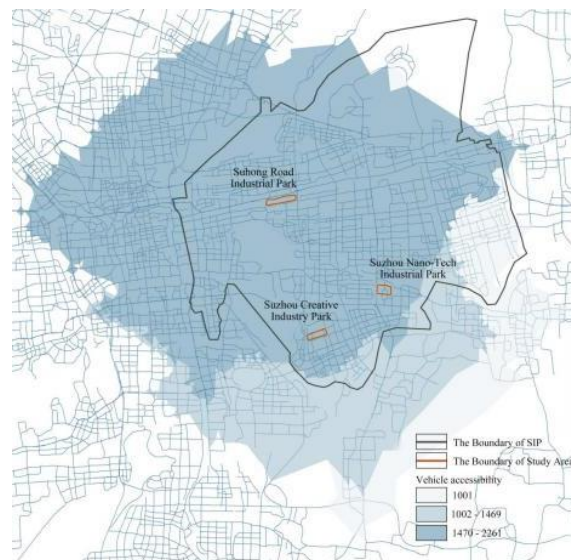


Figure 3: Accessibility distribution.

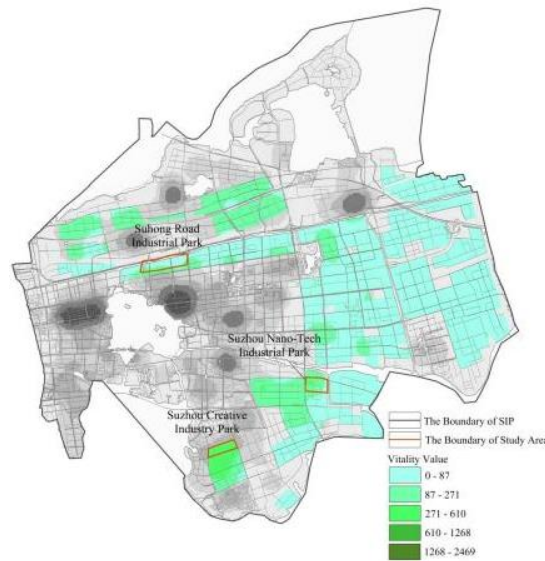


Figure 4: Vitality distribution.

Table 2: Major urban landmarks and number of posts in the study area.

Urban Landmark	Number of Posts (P)	Landmark level value (L_a)
Suzhou Nano-tech Industrial Park	99	0.0078
Suzhou Creative Industry Park	81	0.0064
Suzhou Nanobio Industrial Park	77	0.0061
Suhong Road Industrial Park	56	0.0044
Others: $\sum_{n \in A} P_n = 12698$, $L_{\max} = 0.0670$, $L_{\min} = 0.0014$		

2.3.2. Questionnaire Data for Subjective Indicators

Questionnaire surveys were used to obtain indicator scores for the environmental perception (B2) and sense of place (B3) dimensions and needs related to public space attractiveness. Three typical industrial parks in Suzhou Industrial Park were selected as case samples. The survey was conducted from May 8 to 10, 2025, covering weekdays and the weekend. The respondents were office workers engaging in outdoor activities in the public spaces of the industrial parks. Stratified sampling was used, with the number of questionnaires allocated in proportion to the working population of each park, and questionnaires were randomly distributed in major public spaces such as entrance plazas, courtyard spaces, and commercial-service areas. A total of 170 questionnaires were distributed, of which 161 valid questionnaires were returned, yielding a valid-response rate of 94.7%.

The questionnaire employed a structured design and comprised three parts: (1) basic respondent information, including sex, age, and frequency of public space use; (2) a subjective evaluation scale, which was constructed on the basis of established environmental-psychology scales and the characteristics of public spaces in industrial parks, adopted a five-point Likert scale (1-5 points), and included 2-3 evaluation items for each indicator, with respondents' individual ratings combined to form a composite indicator score; (3) needs related to public space attractiveness, for which specific need-selection items were designed under each indicator score based on a literature review, field research, and interviews with users, together with review by three experts. These items were used to support and explain the specific meaning of the public space attractiveness indicators in industrial parks and were not treated as evaluation subitems.

Descriptive statistics were calculated for respondents in the industrial parks. In terms of sex, 86 respondents were female, accounting for 53.4%, and 75 were male, accounting for 46.6%, indicating a relatively balanced sex ratio. In terms of age, respondents covered several age groups: those aged 18-25, 26-35, 36-45, and 46-59 years accounted for 27.3%, 42.2%, 19.3%, and 11.2%, respectively. Overall, young people predominated, consistent with the demographic composition of industrial parks. In addition, in terms of frequency of public space use, respondents who used the spaces daily accounted for 39.8%, frequent users for 26.7%, occasional users for 27.3%, and those who almost never visited for 6.2%. Thus, most respondents used public spaces relatively frequently.

SPSS 27.0 was used to test the reliability and validity of the questionnaire. The results showed that Cronbach's alpha for the 14 measurement items was 0.823, indicating good reliability. The KMO value was 0.797 (>0.5), and Bartlett's test of sphericity was significant (<0.001), indicating that the questionnaire had good construct validity and that the data were suitable for subsequent statistical analysis.

2.3.3. Indicator Weight Calculation Using the Analytic Hierarchy Process

This study used the analytic hierarchy process (AHP) to determine the weights of the evaluation indicators, combining qualitative and quantitative analyses to fully reflect expert experience and decision-making judgments. Ten experts with more than five years of research experience in urban public spaces were invited to compare the indicators pairwise on the basis of literature analysis and field research, construct judgment matrices, and calculate the weights of indicators at each level using the eigenvector method; the final weights were obtained after normalization. For judgment matrices that failed the consistency test, expert discussions were organized to revise them until the consistency requirement was met ($CR < 0.10$), ensuring the scientific rigor and reliability of the judgment matrices and weight results.

To ensure consistency between objective and subjective data analysis, a linear interval mapping method was used to normalize the indicators of the physical characteristics dimension, mapping X from $[X_{\min}, X_{\max}]$ to the interval $[1, 5]$.

3. Evaluation and Analysis of Public Spaces Attractiveness in Industrial Parks

3.1. Indicator Weights

As shown in Table 3, at the criterion layer, physical characteristics B1 (0.585) has the highest weight and the most significant influence on the attractiveness of public spaces in industrial parks, followed by sense of place B3 (0.260), whereas environmental perception B2 (0.155) has the lowest relative weight. At the indicator layer, accessibility C2 (0.214) has the highest weight, followed by place meaning C10 (0.155) and vitality C4 (0.139), indicating that transport convenience, spatial activity, and place meaning are important factors affecting the attractiveness of public spaces. Functional diversity C1, place identity C9, and landmark level C3 are all at moderate levels, whereas indicators such as comfort C5, aesthetic quality C6, and interest C8 have relatively low weights.

Table 3: Ranking of indicator weight.

Criteria (B)	Criteria Weight	Indicator	Indicator Weight	Ranking
Physical characteristics (B1)	0.58514	Functional diversity (C1)	0.129	4
		Accessibility (C2)	0.214	1
		Landmark level (C3)	0.103	6
		Vitality (C4)	0.139	3
Environmental perception (B2)	0.15462	Comfort (C5)	0.038	8
		Esthetic quality (C6)	0.026	9
		Activity support (C7)	0.069	7
		Interest (C8)	0.022	10
Sense of place (B3)	0.26024	Place identity (C9)	0.105	5
		Place meaning (C10)	0.155	2

3.2. Evaluation Results

As shown in Figure 5, the three industrial parks exhibit relatively clear common characteristics in their overall performance. Indicator scores for comfort (C5) and aesthetic quality (C6) are relatively high in all parks, exceeding 3.5 points, indicating that the overall environmental quality of public spaces in the industrial parks is relatively good and has a certain foundation in terms of landscape environment and place experience. By contrast, most scores for functional diversity (C1), landmark level (C3), and vitality (C4) are below 3 points, representing the poorest overall performance in the scoring system and indicating considerable room for improvement in the functional types, landmark expression, and activity participation of public spaces. Scores for the remaining indicators, including place identity (C9), place meaning (C10), activity support (C7), and interest (C8), range from 3.0 to 3.5 points and are generally moderate, reflecting continued optimization potential in vitality support, interesting experiences, and

affective identification in public spaces within the parks. Although accessibility (C2) performs relatively well in Suhong Road Industrial Park (3.80), all other scores are below 3 points; after averaging, the overall level is relatively low.

In terms of the weighted composite scores (Figure 6), the overall differences among the three industrial parks are not significant. Suzhou Creative Industry Park has a relatively high score (2.90), whereas Suhong Road Industrial Park and Suzhou Nano-tech Industrial Park score 2.70 and 2.48, respectively; the attractiveness of public spaces in all three parks is relatively low. At the dimensional level, the contribution of scores follows a consistent pattern: physical characteristics make the most prominent contribution, followed by sense of place, whereas environmental perception makes a relatively weak contribution.

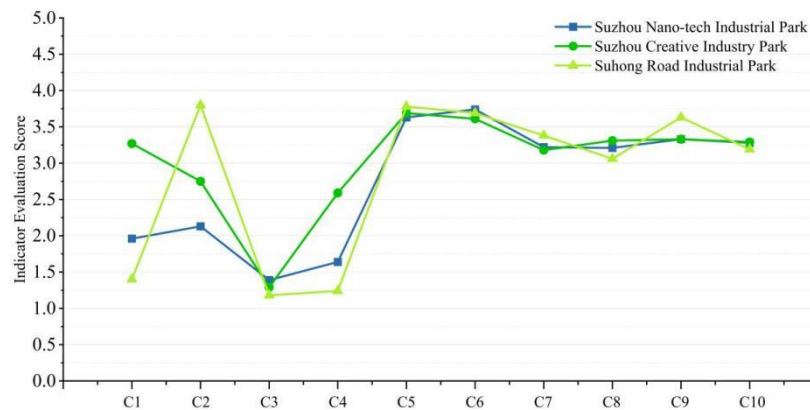


Figure 5: Indicator Evaluation Scores.

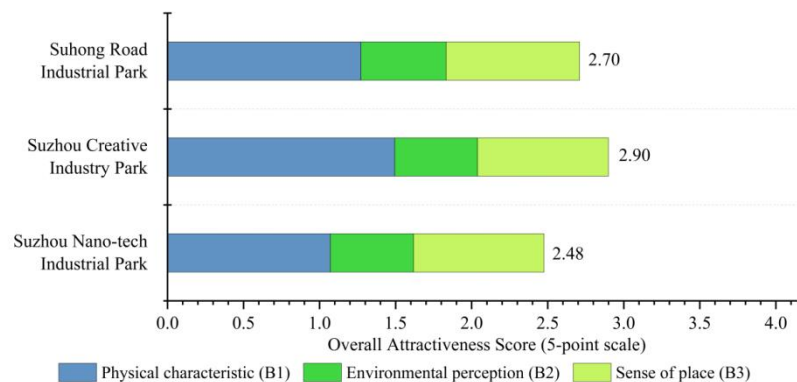


Figure 6: Weighted Composite Score.

3.3. Analysis of Needs Related to Spatial Attractiveness

The preceding sections measured the objective indicators using GIS methods and obtained subjective indicator scores through questionnaire surveys. To further reveal important areas of concern regarding spatial attractiveness, the human-centered characteristics of needs related to spatial attractiveness were explored through frequency statistics. These results supplement the evaluation findings and provide a basis for the subsequent analysis of influencing factors and formulation of optimization strategies.

As shown in Figures 7-9, the characteristics of needs related to spatial attractiveness are clearly shared across the different industrial parks. In terms of environmental perception, respondents generally pay greater attention to environmental elements that can directly improve the experience of using a space. Expectations are relatively high for rest facilities, clean and hygienic environments, distinctive landscape design, commercial-service facilities, and participatory and interactive landscape spaces, whereas needs for nightscape lighting, color combinations, and public-art landscape installations are relatively low. At the level of sense of place, people generally pay greater attention to creating an industrial-cultural atmosphere, improving the overall image of the parks and developing spaces that integrate work, life, and social interaction, whereas the demand for the remaining items is relatively low.

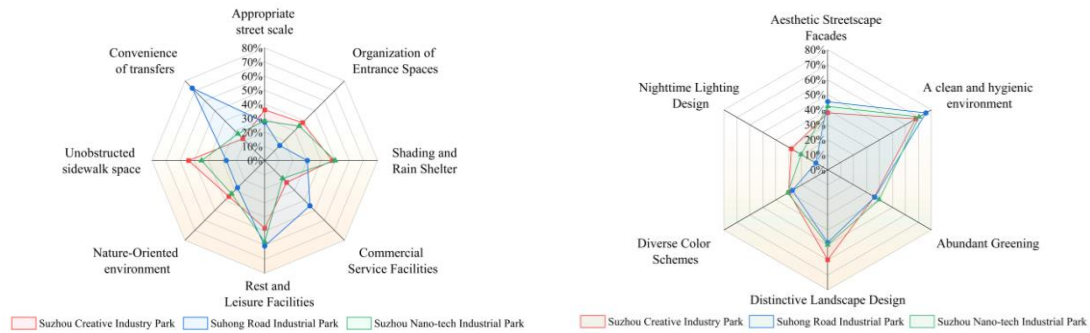


Figure 7: Analysis of the Need for Comfort and Aesthetic quality.

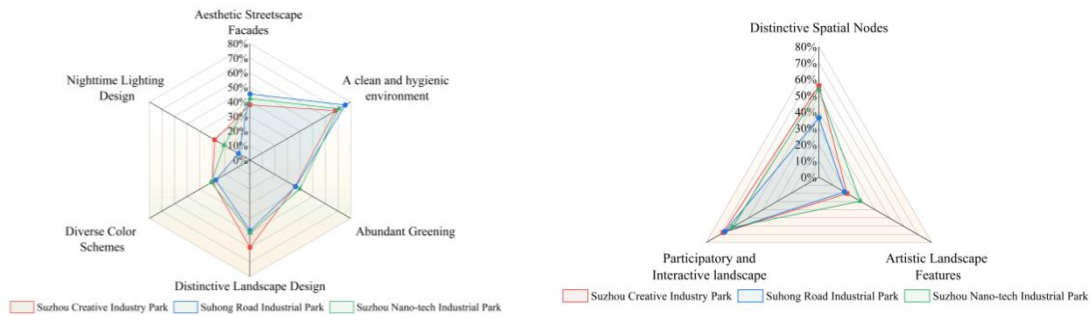


Figure 8: Analysis of the Need for Activity support and Interest.

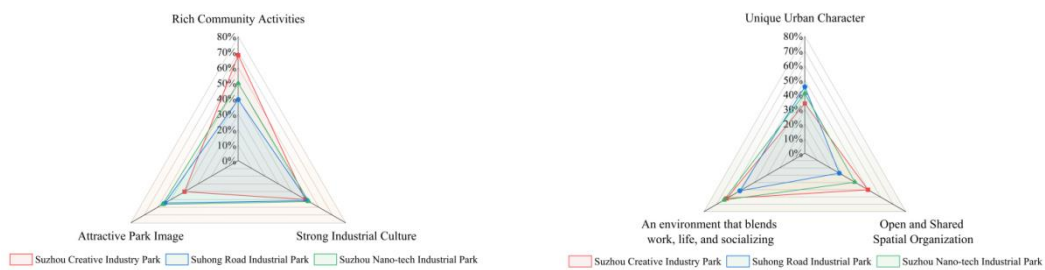


Figure 9: Analysis of the Need for Place identity and Place meaning.

4. Analysis of Factors Influencing Public Spaces Attractiveness in Industrial Parks

4.1. Identification of Influencing Factors

According to the results in Figure 10, place meaning (C10) generally tends toward the 'high importance-high performance' quadrant, indicating that the symbolic meaning of place makes a relatively high contribution to enhancing the attractiveness value of public spaces in industrial parks and is an advantageous factor of current public spaces. Comfort (C5) and aesthetic quality (C6) perform relatively well but have relatively low importance, whereas the weight and score of place identity (C9) are at moderate levels; all three are potential optimization factors. Functional diversity (C1) and vitality (C4) are located in the high-importance-low-performance quadrant and are key factors constraining improvements in public space attractiveness in industrial parks; they should therefore be priorities for future optimization and enhancement. Both the importance and performance of landmark level (C3) are relatively low, and its contribution to overall attractiveness is small. In addition, activity support (C7) and interest (C8) are generally close to the 'low importance-high performance' quadrant but have not fully entered it, indicating that public spaces have a certain foundation in activity support and interesting experiences, although their contributions to overall attractiveness are relatively limited. Although accessibility (C2) has the highest weight, its overall performance is insufficient and differs markedly among the parks, reflecting continued imbalance in transport accessibility across the parks.

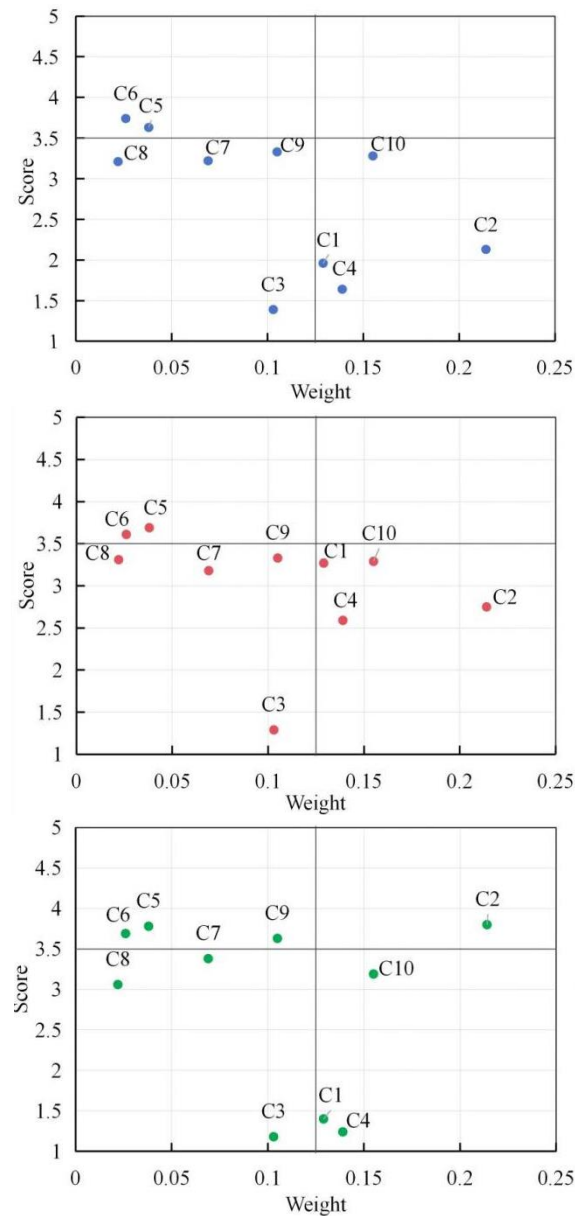


Figure 10: Weight-score plots for Suzhou Nano-tech Industrial Park, Suzhou Creative Industry Park, and Suzhou Road Industrial Park (from top to bottom).

4.2. Analysis of Influencing Mechanisms

4.2.1. Factors in the Physical Characteristics Dimension Make the Most Significant Contribution to Public Spaces Attractiveness

The study finds that spatial physical characteristics constitute the key dimension affecting the attractiveness of public spaces in industrial parks. Among these characteristics, accessibility has the greatest influence, demonstrating the importance of transport convenience and road continuity in existing industrial parks for enhancing spatial attractiveness. However, overall performance is moderate, and differences remain among the parks, leaving considerable room for future improvement. For example, the research-oriented Suzhou Nano-tech Industrial Park and the cultural and creative Suzhou Creative Industry Park should focus on strengthening transport connections with their surrounding environments. To a certain extent, this finding corroborates that of Ding et al., namely, that spatial accessibility can substantially enhance the vitality and quality of spaces in industrial parks. In the future, parks should focus on improving the transport convenience of public facilities [5].

In addition, functional diversity also occupies an important position of influence. Increasing the types and numbers of facility functions can enhance spatial attractiveness, which is similar to the conclusion of

Li et al. that the number of park facilities can improve spatial attractiveness^[14]. However, the overall level of functional diversity is poor, indicating that the functional facilities in public spaces within industrial parks are relatively homogeneous. Meanwhile, the landmark level is also generally low, reflecting clear deficiencies in spatial legibility and the expression of cultural symbols in the parks, which may weaken users' cognitive experience and sense of emotional belonging. Notably, there is a certain mismatch between the level of vitality and the degree of activity support: spatial vitality scores are moderately low, whereas activity support performs relatively well. This reflects a disconnect between facility provision and actual use behavior. Although the existing public-activity facilities in the parks provide various forms of support, they have not translated into high-frequency, highly participatory spatial vitality. This may be because public spaces in industrial parks mainly serve work-oriented daily activities, and employees' length of stay and types of activity are influenced by corporate systems and a culture of efficiency, resulting in relatively limited time for employees' activities in public spaces.

4.2.2. Factors in the Sense of Place and Environmental Perception Dimensions Reinforce and Supplement Spatial Attractiveness, Respectively

The results show that the place meaning indicator in the sense of place dimension makes a relatively large contribution to the attractiveness value and is an advantageous factor. This indicates that the symbolic meaning of space helps reinforce the attractiveness performance of public spaces in industrial parks and also reflects the important role of public spaces in meeting employees' psychological and emotional needs, thereby amplifying the fundamental effect of physical characteristics on attractiveness. In addition, employees have relatively high expectations for the integration of 'work-life-social interaction' and the creation of an industrial-cultural atmosphere, but relatively weak demand for open and shared spaces. This indicates that parks need to place greater emphasis on shaping social interaction and cultural atmosphere, thereby strengthening the cultural expression and emotional integration of public spaces.

At the same time, the environmental perception dimension has relatively low importance, but its indicators, such as aesthetic quality and comfort, perform relatively well overall. This indicates that environmental perception functions more as a supplementary factor to objective conditions; nevertheless, it cannot be overlooked in optimizing user experience and stimulating willingness to use the space. This finding is exactly the opposite of the conclusion by Han et al. that experiential perceptions of recreational spaces are markedly more important than spatial attributes^[15]. This may be related to the characteristic high-efficiency use of industrial spaces, and their potential to attract users through environmental perception remains to be explored. Nevertheless, to develop high-quality parks, spatial support for activities and the degree of interest within environmental perception remain factors for future optimization and can provide important support for further enhancing the attractiveness effects of environmental perception in the parks. The study also finds that park users have relatively high expectations for rest and commercial-service facilities and interactive landscape design, but relatively low demand for public-art landscapes. This differs from the conclusion of Motoyama et al. that public art can continuously attract attention in urban landscapes^[16], possibly because of differences in the types of urban spaces: urban parks and squares place greater emphasis on creating an artistic atmosphere than do public spaces in industrial parks.

5. Conclusions

Taking Suzhou Industrial Park as an example, this study systematically evaluates the attractiveness of public spaces in industrial parks by constructing a three-dimensional attractiveness evaluation system and reveals general patterns that influence such attractiveness. The main conclusions are as follows: (1) factors in the physical characteristics dimension make relatively substantial contributions to the composite attractiveness values, whereas sense of place and environmental perception play reinforcing and supplementary roles, respectively; (2) the physical characteristics dimension has a relatively high weight, but functional diversity, landmark level, and vitality perform poorly and are key factors in improving public spaces; (3) the sense of spatial meaning makes a relatively high contribution to the attractiveness value and becomes an advantageous factor of public spaces. Comfort, aesthetic quality, and place identity make moderate contributions but remain potential directions for optimization, whereas activity support and interest show ordinary performance and are also important factors for improving attractiveness. Among them, the provision of functional facilities, social-interaction spaces, distinctive landscape nodes, and an industrial-cultural atmosphere are priority needs for enhancing the attractiveness of public spaces in the parks.

To further guide industrial park planning, design, and operational practices, this study proposes the following optimization strategies: (1) enhance spatial landmark level and cultural expression by installing landmark landscapes or industrial-cultural symbols to strengthen spatial legibility and affective identification; (2) optimize functional diversity and activity layouts by integrating office, commercial, leisure, and social functions and providing diverse activity venues and themed activities to enhance spatial vitality; (3) improve road and pedestrian systems, increase accessibility within the parks and to surrounding areas, and reduce transport barriers; (4) strengthen the creation of environmental experiences and emotional belonging, including by adding interactive landscapes, improving rest facilities, and organizing community activities, thereby achieving coordinated improvements in spatial functions and emotional value.

However, this study still has certain limitations. It is based on only three typical industrial parks in Suzhou Industrial Park, and the sample scope is limited. Future studies could expand the study sample, explore comparisons and generalizability across different types of industrial parks, and further combine spatial-use behavior with perception data to monitor and optimize public space attractiveness.

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