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Strategy for the Environmental Service Quality Assessment and Improvement of the Parks Based on Fuzzy-IPA- A Case Study of the Park in Xinxiang Economic Development Zone

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Abstract

Park has important ecological, social and economic values serving as an urban open space with high usage frequency. After its completion, the environmental service quality of the park should be constantly improved to better serve the public. The park in Xinxiang Economic Development Zone, Henan Province, is investigated in this study. A total of 18 environmental service quality indicators of the park are included for the assessment of the public's perception of the importance and performance of environmental service quality of the park by IPA method. The results showed that all the 18 indicators have high importance in the environmental service quality of the park. In contrast, the performance of the public towards the park is generally low. The paired-sample t-test further confirms the significance difference between the importance and the performance of 16 indicators. The 18 indicators are divided into four categories: indicators requiring sustained efforts, indicators requiring emphatic improvement, indicators requiring moderate development and indicators requiring maintenance. Varying countermeasures need to be adopted depending on the category of the indicators to promote the environmental service quality of the park.

Keywords: *Park environment, Service quality, Assessment, IPA*

1. Introduction

Park is one of important components of urban green space system and also provides the activity site for the recreation of the public. In many cities, park is the 'green lung' that plays the crucial role in improving the urban ecological environment quality of the city. Moreover, the park is significantly effective in reducing the heat island effect of the city [1]. Park is also one of the regions with the highest biodiversity in the urban space, and has an important role in protecting the animals and plants in cities [2]. As the space for public interaction, the park also performs important social functions [3]. Urban park belongs to public utility, and creates huge indirect economic value but a low direct economic value [4]. The construction of the park is usually guided by the government, which assigns the design and planning task to a specific institution. After completion, the park is open to the public for free. Before construction, the design schemes are usually reviewed by the experts and the public. But it is still unknown whether the environmental quality of the park can meet the public demands. The composition of the public is highly complex in terms of age, sex, income level and

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educational background, which gives rise to the diversity in demand [5]. The design of the park has to consider the usage demands of the general public as well as the demands of the special groups. The operation and usage of the park are accompanied by the emergence of a variety of problems, which raises challenges for the constant maintenance and upgrading of the park. The service quality assessment has been widely applied in such fields as product design, hospital service, satisfaction degree of the consumers [6] and tourism service [7]. It is already established as a mature system for quality assessment. An objective assessment of the service quality of the park can provide reference for the upgrading and reconstruction of the park.

IPA (importance-performance analysis) is widely applied in the service quality assessment of leisure and recreational industry [8], typically the hotel services, satisfaction degree of the tourists [9], tourism management [10] and cultural perception [11]. IPA (Figure 1), as a simple and effective assessment tool, can reflect the perceived importance of each indicator of environmental service as well as the degree of public's satisfaction in terms of each indicator on a two-dimensional coordinate system. Based on this, the targeted strategy can be formulated. In many situations, the public's attitude towards a specific aspect of the park service cannot be described by an exact value, but the attitude can be qualitative studied by questionnaire. Fuzzy technique allows the conversion of qualitative data in the questionnaire into quantitative data through the use of scales. Likert scale is most commonly used among the scoring scales. This scale consists of a group of statements, under which different options are provided for the choice by the respondents. Fuzzy-IPA method is used to assess the environmental service quality of the park, based on which the improvement measures are proposed.

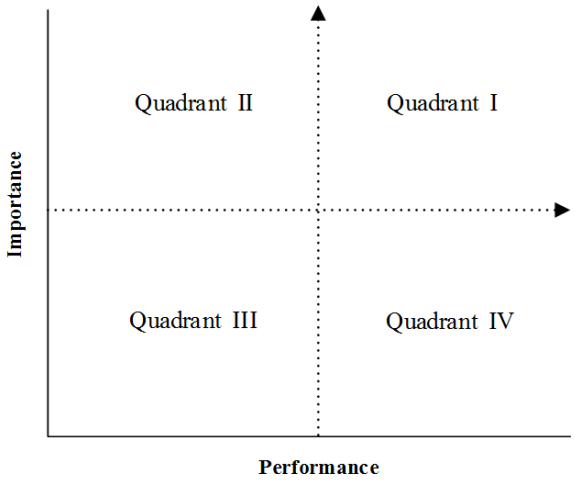


Figure 1. Chart of Importance-Performance Analysis

2. Materials and Methods

2.1. Object of Research

The park of Xinxiang Economic Development Zone in Henan Province is the object of the research. The park covers an area of 4.88 hectares and was constructed in 2010. A total of 263 questionnaires were distributed, and 228 were retrieved. The retrieval rate was 86.7%. With the removal of unqualified questionnaires, the valid questionnaires totaled 207. The statistics

showed that the males accounted for 61% of the respondents, and the females accounted for 39%.

2.2 Questionnaire Design

2.2.1 Questions: According to the results of literature retrieval, 29 terms with high occurrence frequency in park environment studies were included. After interview and survey with the design personnel, review experts and the general public, 18 indicators classified into 6 categories were finally screened (Table 1).

Table 1. Indicators for Environmental Service Quality Assessment of the Park

Categories	Influence factors	Explanation of the indicator
Tangibility	Topographical design	Form and size of topography
	Water system design	Form and scale of water system
	Plant landscape design	Aesthetic effect of plant landscape
	Building design	Form, color and scale of building design
	Road design	Form and width of road
Convenience	Site distribution	Spatial distribution of activity sites
	Type of site	Diversity of activity sites
	Accessibility	Accessibility of roads
Healthfulness	Fitness facilities	Number and quality of fitness facilities
	Eco-environment	Quality of eco-environment
Caring feature	Humanization	Comfortability of the facilities
	Cultural quality	General cultural connotation of the park
Safety	Traffic safety	Vehicle management of the park
	Safety of the facilities	Firmness and durability of the facilities
	Water and electricity safety	Safety level of water and electricity
Management level	Greenland maintenance	Daily management of lawn and trees
	Maintenance of hard landscape	Repair and maintenance of hard landscape
	Cleanliness	Management of environmental sanitation

2.2.2 Scale: Five-point Likert scale was used. For the questions about the importance of each indicator, five options were provided: "very important", "important", "neutral", "unimportant", "very unimportant". To each option, the scores of 5, 4, 3, 2, 1 were assigned, respectively. For the questions about the performance of the respondents, five options were provided: "very satisfied", "satisfied", "neutral", "unsatisfied", "very unsatisfied". These five options were scored as 5, 4, 3, 2, 1, respectively.

2.3. Data Analysis

Cronbach Alpha coefficient was used to measure the reliability of the questionnaire. When α coefficient was larger than 0.7, it was indicated that the questionnaire designed had a high reliability; when the value was lower than 0.35, the questionnaire had a low reliability, and was not suitable for use. If the value was between 0.35 and 0.7, the reliability was of a moderate degree, and the questionnaire design was acceptable. The α coefficients of importance-related and performance -related questions were 0.602 and 0.787, respectively. Thus, the questionnaire design was acceptable.

The statistical analysis of the data was performed using SPSS 20. The mean values, standard deviations and mean deviations of the scores for the importance-related and performance-related questions were calculated and subjected to paired-sample t-test.

The application program of IPA is described as follows:

(1) The survey indicators and scales are first determined;

(2) The scores of the importance (I) and performance (P) of each indicator are established; the graduated IP plot is drawn.

(3) According to the scores of the importance and performance for each indicator, the indicators are marked in one of the four quadrants.

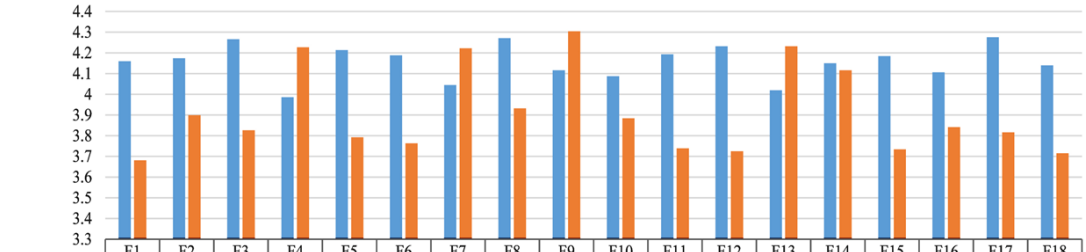
(4) The indicators falling into the quadrants are explained. Quadrant I is the high-P and high-I region, which is considered as high importance and high performance. The corresponding countermeasure is the sustaining of efforts; quadrant II is the low-P and high-I region, which is considered as high importance but low performance. The corresponding countermeasure is emphatic improvement; quadrant III is low-P and low-I region, which is considered as moderate performance and low importance. The countermeasure is to give the lowest priority to the corresponding indicator; quadrant IV is high-P and low-I region, which is considered as moderate importance and high performance. The countermeasure is the maintenance of the status quo.

3. Results and Discussion

3.1. Results and Discussion about the Importance and Performance

3.1.1 Importance: In Table 1, the mean scores of the perceived importance of 18 indicators on the environmental quality of the park are 3.986~4.275, indicating a relatively high satisfaction degree of the public. But all the standard deviations are lower than 1.14, indicating a small discordance in opinions and attitudes. In terms of the mean scores, cleanliness (M = 4.275), type of site (M = 4.271), plant landscape design (M=4.266), ecological environment (M=4.232), water system design (M=4.213) and fitness facilities (M=4.193) rank the top 1/3.

3.1.2 Performance: As shown by the scores of perceived performance in Figure 2 and Table 2, the mean scores of the satisfaction degree with respect to 18 indicators on the



	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	F18
Importance	4.159	4.174	4.266	3.986	4.213	4.188	4.044	4.271	4.116	4.087	4.193	4.232	4.019	4.15	4.184	4.106	4.275	4.14
Performance	3.681	3.899	3.826	4.227	3.792	3.763	4.222	3.932	4.304	3.884	3.739	3.725	4.232	4.116	3.734	3.841	3.816	3.715

Figure 2. Histogram of IPA

environmental quality of the park are 3.681~4.304. Most scores are lower than the corresponding importance scores. This indicates that the majority of the public is not so satisfied with the current situation of the park of Xinxiang Economic Development Zone. As

shown by the standard deviations, the perceived performance of the public diverges greatly compared with the perceived importance. Generally, the public shows a high satisfaction towards humanization (M=4.304), traffic safety (M=4.232), building design (M=4.227), accessibility (M=4.222) and safety of the facilities (M=4.116). In contrast, the performance towards site distribution, fitness facilities, water and electricity safety, ecological environment, greenland maintenance and topographical design are low.

Table 2. Ranking of Mean Value and Standard Deviation of Importance and Performance

Categories	SN	Influence factors	Importance			Performance		
			Mean	SD	Order	Mean	SD	Order
Tangibility	F1	Topographical design	4.159	0.990	10	3.681	1.184	18
	F2	Water system design	4.174	0.990	9	3.899	1.121	7
	F3	Plant landscape design	4.266	1.011	3	3.826	1.110	10
	F4	Building design	3.986	1.104	18	4.227	0.777	3
	F5	Road design	4.213	1.002	5	3.792	1.111	12
Convenience	F6	Site distribution	4.188	1.051	7	3.763	1.165	13
	F7	Type of site	4.044	1.021	16	4.222	1.023	4
	F8	Accessibility	4.271	0.720	2	3.932	1.068	6
Healthfulness	F9	Fitness facilities	4.116	0.840	13	4.304	1.038	1
	F10	Eco-environment	4.087	1.034	15	3.884	1.059	8
Caring feature	F11	Humanization	4.193	0.991	6	3.739	1.162	14
	F12	Cultural quality	4.232	0.992	4	3.725	1.143	16
Safety	F13	Traffic safety	4.019	1.140	17	4.232	0.779	2
	F14	Safety of the facilities	4.150	0.934	11	4.116	0.963	5
	F15	Water and electricity safety	4.184	1.099	8	3.734	1.167	15
Management level	F16	Greenland maintenance	4.106	0.999	14	3.841	1.136	9
	F17	Maintenance of hard landscape	4.275	0.722	1	3.816	1.086	11
	F18	Cleanliness	4.140	0.833	12	3.715	1.120	17

3.2. Location of the Indicators in the Four Quadrants

Table 3 shows the mean difference and Sig. (2-tailed) of importance and performance of 18 indicators. The mean value of all importance-related indicators is 4.156, while that of all performance-related indicators is 3.914. Taking these two mean values as the origins, the importance and performance scores of all indicators are plotted. Thus, the IPA location diagram containing all indicators is obtained (Figure 3).

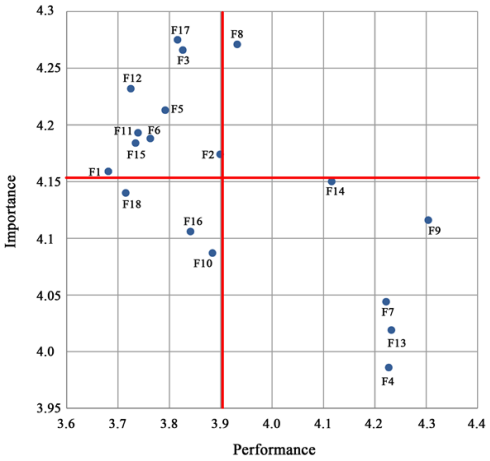


Figure 3. Quadrantal Diagram of IPA

3.2.1. First Quadrant: Indicator F8 falls into the first quadrant, and hence belongs to the indicator that requires sustained efforts. The countermeasure is to invest sustained efforts while maintaining the current service quality.

3.2.2. Second Quadrant: Indicators F1, F2, F5, F6, F11, F12, F15 and F17 fall into this quadrant. These 8 indicators are important to the public but the public is generally unsatisfied with the performance of these indicators. They need emphatic improvement and are the priority problems to be addressed. The countermeasure is to enhance the labor, resources and capital investment in these aspects.

Table 3. Mean Difference and Sig. (2-tailed) Between Importance-Performance

SN	I	P	P-I	t	Sig. (2-tailed)
F1	4.159	3.681	0.478	3.720	.000
F2	4.174	3.899	0.275	2.500	.013
F3	4.266	3.826	0.44	4.383	.000
F4	3.986	4.227	-0.241	-2.559	.011
F5	4.213	3.792	0.421	3.669	.000
F6	4.188	3.763	0.425	3.848	.000
F7	4.044	4.222	-0.178	-1.771	.078
F8	4.271	3.932	0.339	3.964	.000
F9	4.116	4.304	-0.188	-2.052	.041
F10	4.087	3.884	0.203	1.976	.049
F11	4.193	3.739	0.454	4.172	.000
F12	4.232	3.725	0.507	4.885	.000
F13	4.019	4.232	-0.213	-2.150	.033
F14	4.150	4.116	0.034	.333	.739
F15	4.184	3.734	0.45	3.930	.000
F16	4.106	3.841	0.265	2.535	.012
F17	4.275	3.816	0.459	5.159	.000
F18	4.140	3.715	0.425	4.408	.000

3.2.3 Third Quadrant: Indicators F10, F16 and F18 fall into this quadrant, suggesting that they are not so important for the public and the public is unsatisfied about them. They should be assigned low priority in handling. The countermeasure is to enhance the capital investment and to pay greater attention to these indicators.

3.2.4 Forth Quadrant: Indicators F4, F7, F9, F13 and F14 fall into this quadrant, suggesting that they are not so important to the public, and the public is generally satisfied about them. No more resources and capital should be invested in improving these indicators. The countermeasure is to maintain the current scale and status.

3.3. Error Analysis

The following aspects should be improved or reinforced: (1) The 18 indicators chosen for the environmental service quality assessment are based on the previous research and our interviews. So the subjectivity is inevitable. The pre-sampling technique can be employed to increase the scientificity of the research; (2) Since many visitors refused to answer the questionnaire, the representativeness and the authoritativeness of the valid questionnaires are low. This defect can be modified by increasing the sample size.

4. Conclusion

The park of Xinxiang Economic Development Zone, Henan Province is assessed in terms of the environmental service quality through 18 indicators. The IPA method is used to reveal the basic condition of public's satisfaction towards the park in a graphical, clear and intuitive manner. The gap is found between the current environmental service quality and the actual demand of the public. The 18 indicators are divided into 4 categories: indicators requiring sustained efforts, indicators requiring emphatic improvement, indicators requiring moderate development and indicators requiring maintenance. The countermeasures should vary depending on the category of the indicator to improve the environmental service quality of the park.

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