

# Framework for Enhancing Park Service Effectiveness Leveraging Emerging Technologies

Xiaoxian ZHANG<sup>1</sup>, Zihao LI<sup>2</sup>, Yanxiang ZHAO<sup>2</sup>, Yating ZENG<sup>1</sup>, Teng WANG<sup>1,\*</sup>

<sup>1</sup> Beijing City Quadrant Technology Co. Ltd., Beijing 100027

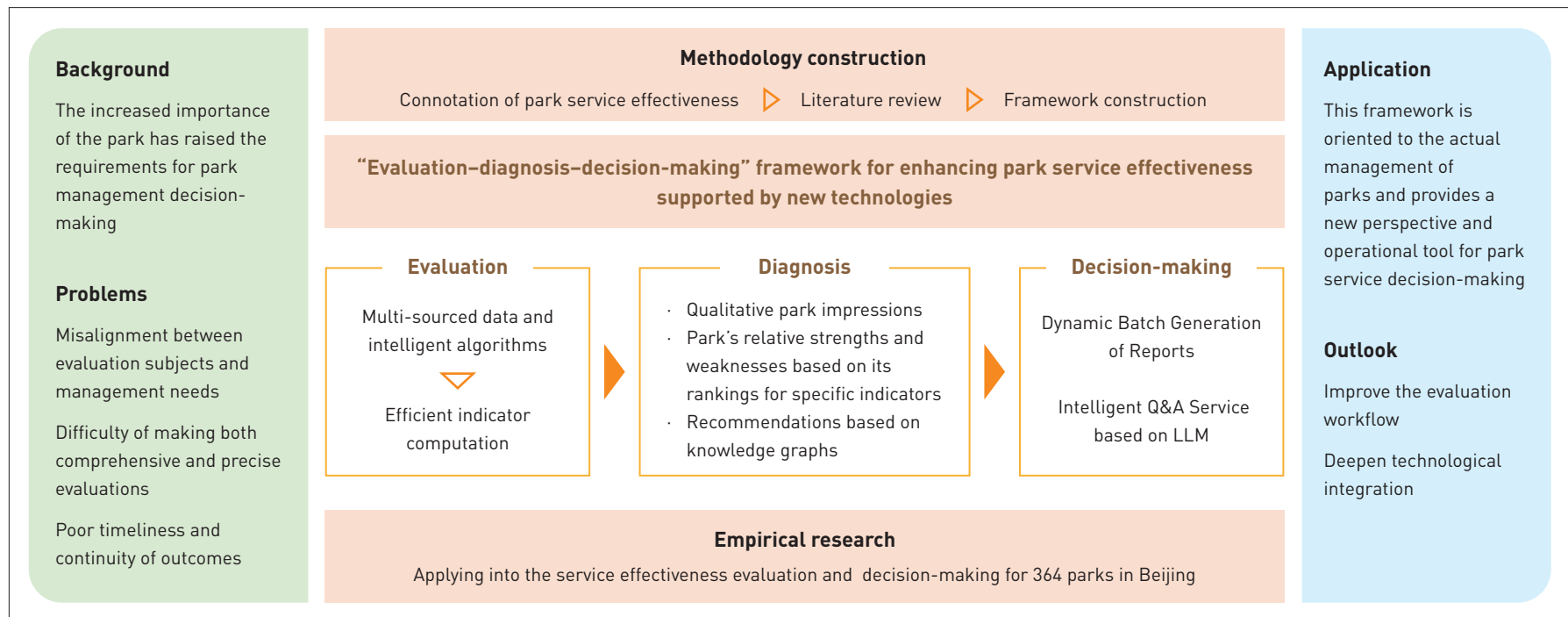
<sup>2</sup> Big Data Center of Beijing Municipal Forestry and Parks, Beijing 101118

\*CORRESPONDING AUTHOR

Address: B12-13, Tianding 218 Cultural and Financial Park, No. 16 Zhushikou East Street, Dongcheng District, Beijing 100027, China

Email: wangteng@urbanxyz.com

## GRAPHICAL ABSTRACT



## ABSTRACT

Effectively enhancing park service effectiveness is a pivotal pathway for advancing the construction of Park Cities. However, it has currently witnessed issues such as the misalignment between park management research and the actual deficiencies, a lack of connections from evaluation results to deficiency diagnosis and optimization recommendations, and the insufficiency in timeliness and continuity of research outcomes, which collectively fail to adequately support for park managers’ decision-making in service effectiveness enhancement. This study, addressing the entire workflow, proposes an “evaluation–diagnosis–decision-making” framework for the enhancement of park service effectiveness

underpinned by new technologies. Initially, by leveraging multi-sourced data to expand the investigation dimensions of park service effectiveness, it conducts indicator evaluations with intelligent algorithms; subsequently, constructing knowledge graphs to achieve precise deficiency diagnosis and optimization recommendations; and finally, utilizing templates and intelligent technologies for automatic report generation, and introducing an intelligent question-and-answer service supported by the large language model, thereby offering refined evaluation, diagnosis, and decision-making assistance for enhancing park service effectiveness. With an empirical case study on the evaluation of

park service effectiveness in Beijing, the article demonstrates the application effectiveness of this framework, which can provide a new perspective and an operational tool for the improvement of urban park management services.

## KEYWORDS

Park Service Effectiveness; Park Management; Management Decision-making; Multi-sourced Data; Knowledge Graph; Large Language Model

## HIGHLIGHTS

- Accurately identifies park deficiency and provides recommendations through intelligent algorithms
- Applies evaluation results into the workflow of park management strategies by knowledge graphs
- Automatic report generation to enhance the efficiency of park service effectiveness evaluation
- Utilizes LLM-based Q&A service for refined evaluation, diagnosis, and decision-making at a lower cost

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## 1 Introduction

Urban park and green spaces are important public resources for cities and closely related with public health, ecological and environmental quality, and social well-being<sup>[1]</sup>. Meanwhile, new social demands are emerging continuously, especially for the rising construction of “Park Cities” and “Forest Cities” in China. This makes how to enhance park service effectiveness to support urban regeneration and renewal a difficult task that park managers must face<sup>[2]</sup>. At present, as the rapid development and wide application of new technologies such as big data and artificial intelligence have provided new opportunities for improving the service effectiveness of parks, this paper explores their application in the full-process workflow under an “evaluation–diagnosis–decision-making” framework for enhancing park service effectiveness, aiming to propose an effective method that improves the actual management of urban parks.

## 2 Literature Review

“Effectiveness” is a term in management academia. Peter F. Drucker believed that effectiveness refers to the ability to select appropriate goals and achieve them<sup>[3]</sup>. Chinese scholars generally interpret the connotation of effectiveness as effect, efficiency, and ability<sup>[4][5]</sup>. Referring to the existing research on the connotation of effectiveness<sup>[6]</sup>, this paper defines “park service effectiveness” as the service effectiveness of a park and the service capability of its park managers. To enhance park service effectiveness, it is necessary to evaluate the existing service effectiveness and capabilities, and make adjustment decisions according to the evaluation results. This requires a clear decision-making cascade, from scientific evaluation system for park service effectiveness and efficient evaluation technologies to effective application of evaluation results.

In the dimension of evaluation system, existing research divided park effectiveness into four categories—ecological, economic, social, and comprehensive—and summarized the evaluation content for each<sup>[7]</sup>. Regarding evaluation scales, the macroscopic evaluation research focuses on the accessibility, distribution equity, and vitality of urban parks<sup>[8]~[10]</sup>, while the microscopic evaluation studies focus on certain park types or individual parks, with a focus on the visitor volume, visitors’ satisfaction, and facility configuration<sup>[11][12]</sup>. In terms of evaluation technologies, UAV (unmanned aerial vehicle) remote sensing, text analysis, geospatial analysis, and big data technology have been widely used<sup>[13]~[16]</sup>. Traditional data (e.g., statistical data, questionnaire survey data, remote sensing data) and emerging data (e.g., Internet map data, mobile signaling data, public opinion data) have all supported various types of effectiveness evaluations<sup>[17]~[19]</sup>. For the application, although scholars have studied how to inform the decision-making of relevant management departments based on evaluation results<sup>[20]</sup>, the follow-up strategic recommendations put forward often vary in specificity and comprehensiveness.

In general, although existing studies can provide support from different perspectives for decision-making of park service effectiveness enhancement, most of them emphasize evaluation over application, and the construction of decision-making cascade is relatively weak, especially in the following three aspects. First, there exists a misalignment between park management research and the actual deficiencies. Current research concentrates on the service effectiveness of specific park types and tends to offer generic recommendations, neglecting the need for precise deficiency-finding and targeted solutions of individual parks in daily management. Second, existing studies frequently examine a

singular effectiveness category and the data used often struggle to meet the dual demands of comprehensiveness and specificity. Third, actual park management emphasizes timeliness and continuity, but the majority of existing research outcomes are isolated and lagging in effectiveness, and there is scant discussion on how to provide ongoing decision-making support under cost constraints.

In response to the limitations in traditional technical means and approaches, this study, addressing the entire workflow of enhancing park service effectiveness, proposes an “evaluation–diagnosis–decision-making” framework supported by novel technologies. This method innovatively integrates a multitude of technologies, enabling a comprehensive investigation of park service effectiveness and the precise formulation of diagnosis and optimization suggestions, and effectively informing park managers to develop actionable plans.

### 3 Establishment of the “Evaluation–Diagnosis–Decision-making” Framework for Park Service Effectiveness Evaluation

The “evaluation–diagnosis–decision-making” framework proposed in this study for evaluating park service effectiveness is illustrated in Fig. 1. Evaluation, as the initial step, commences with the investigating and monitoring of common data, particularly various types of active sensing data, and subsequently intelligent algorithms such as text and visual algorithms are employed to construct and compute service effectiveness indicators. At the diagnosis stage, subjective diagnoses are used to generate

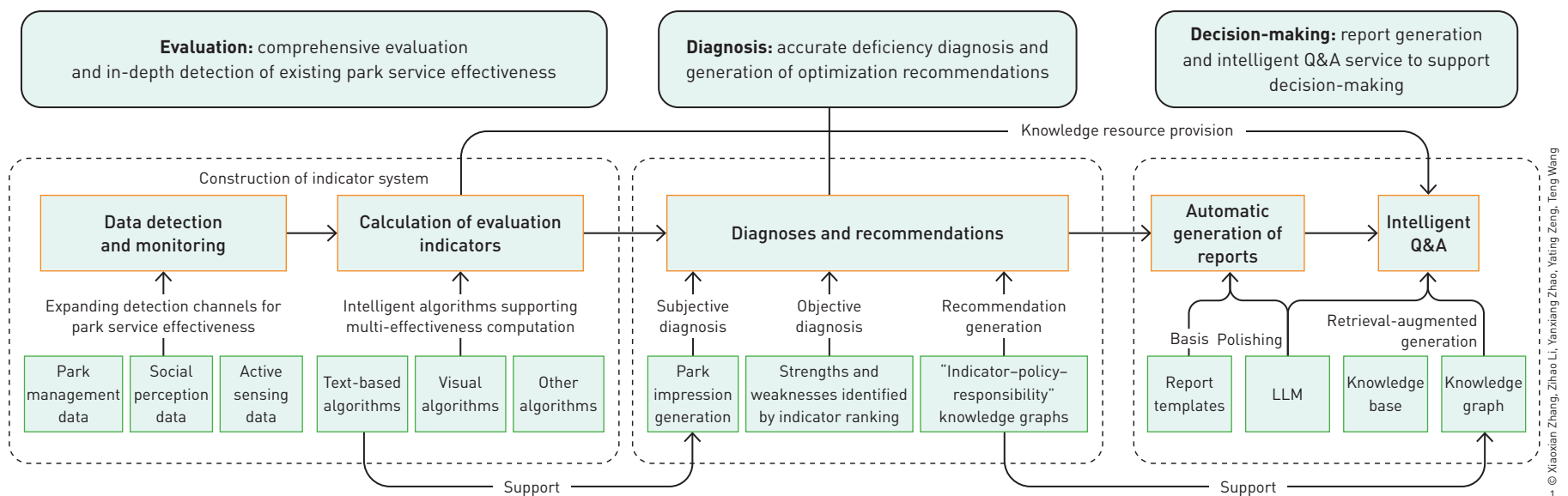
qualitative impressions about the park and then its strengths and weaknesses are identified based on computations and analyses of each indicator. Leveraging knowledge graph technology, the indicators are correlated with respective responsible entities and relevant policies to generate targeted recommendations. Finally, decision-making tailored to actual park management scenarios is supported with automatically-generated periodic evaluation reports that use templates and intelligent technologies. Evaluation reports and related knowledge are integrated into an intelligent question-and-answer (Q&A) service with large language model (LLM), providing park managers with a convenient query tool for decision-making.

#### 3.1 Methods for Investigation and Computation of Park Service Effectiveness

##### 3.1.1 Multi-Sourced Data for Investigating Park Service Effectiveness

To comprehensively cover the data for investigating park service effectiveness, this study categorized commonly used data into different types<sup>[21]</sup> (Table 1). Specifically, park management data refers to data collected, recorded, and analyzed about park operations, environmental conditions, and visitor activities. Social perception data refers to large amount of spatio-temporal data collected through modern information technologies. This type of data is characterized by broad coverage and rapid updates, effectively compensating the data gaps about emerging park usage behaviors and scenarios, such as Citywalk<sup>[21]</sup>. Active sensing data refers to detailed data about the built environment of parks, collected in a targeted manner using

1. The “evaluation–diagnosis–decision-making” framework for enhancing park service effectiveness.



**Table 1: Commonly used data categories for park service effectiveness evaluation**

Data type	Representative data	Content	Application value	Limitation
Park management data	Location data	Park names and location information	Basic data for park distribution evaluation	—
	Statistic data	Records of park management, including park type, area, management entity, greening ratio, quantity of trees, park road length, and barrier-free facilities (distribution, quantity, category, maintenance date)	Information about park facilities, services, and management, providing a basis for park service effectiveness evaluation in multiple aspects	Slow data update frequency, typically annually
	Fixed-point environmental monitoring data	Information of temperature, humidity, wind power, air quality, etc.	For park environmental evaluation	Depend on sensor distribution, with low accuracy
	Landscape monitoring data	Information of groundwater level, soil moisture, vegetation growth, pest infestation, etc.	For park environmental evaluation	Depend on sensor distribution, with low accuracy
Social perception data	Resident demand data	Complaints, suggestions, and inquiries from municipal service hotlines and other feedback channels	High spatial and temporal accuracy, providing a bottom-up perspective for park service effectiveness evaluation	Multi-sources for data acquisition, with high technical requirements for data processing
	POI data	Names and locations of park entrances and facilities within and surrounding the park	To evaluate park facility accessibility and coverage	Errors may exist, requiring cleaning and correction
	Residential data	Information of residential areas within the service radius of the park, including names, number of households, construction year, gross area, and housing price	To analyze the supply-demand match between park coverage and population distribution	Errors may exist, since actual number of park users cannot be fully represented by residential statistics
	Mobile signaling data	Information of tourist flow, structure, and starting location	To analyze park tourist flow and age-friendliness	High cost of data acquisition
	Review data	Tourist reviews and ratings posted on the park's online platforms	To measure park satisfaction and extract public perception of the park	High technical requirements for data analysis
	Event/activity data	Names, types, time, scale, and publicity of park events/activity	To analyze park's operational vitality	Only cover online posted events
Active sensing data	Social media data	Public posts about the park on social media and their view times, likes/comments, etc.	To assess the park's social influence	Limited representativeness, high cost of multi-sourced data acquisition
	Panoramic photos	Panoramic photos and their shooting time, location, etc.	Utilize computer visual technology to identify and evaluate park facility distribution and service quality	High technical requirements for data analysis
	Road bumpiness data	Data of road bumpiness at different time periods and locations	To evaluate the barrier-free construction of the park	Require hardware support
	Environmental mobile sensing data	Temperature, humidity, air quality, odor, noise, and corresponding spatial-temporal information	For overall and detailed evaluation of park environmental quality	Require hardware support
	Survey and interview data	Information collected for specific purposes	For in-depth analysis and evaluation from various dimensions	High labor cost, difficult to scale up

**NOTE**

The contents about social perception data were sourced from Ref. [21].

sensing equipment, which, through algorithmic analysis, enables deficiency-finding of facility damage and shortage like barrier-free or outdoor fitness facilities. The integration and combined use of multi-sourced data provides a robust support for the exploration of park service effectiveness.

### 3.1.2 Intelligent Algorithms for Indicators

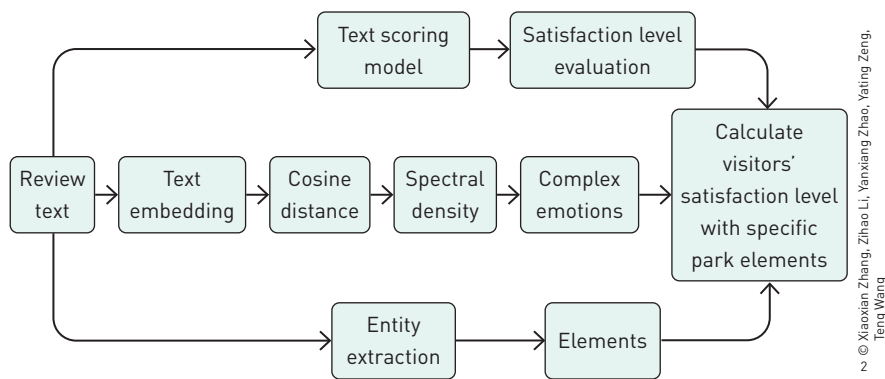
This study does not propose a universal indicator system (a “one-size-fits-all” framework) for park service effectiveness evaluation; instead, it advocates that the indicator system should be tailored to specific evaluation targets, where intelligent algorithms offer adaptable solutions and enable broader-scope, refined computation of indicators<sup>[22]~[24]</sup>. Intelligent algorithms in this study are

categorized into text-based, visual, and other types<sup>[25]~[34]</sup> (Table 2), and the application of the former two algorithms will be elaborated.

For text-based indicator computations, text algorithms can be used to analyze visitors’ satisfaction level with specific park elements (Fig. 2). In contrast to conventional methods that could only differentiate positive and negative emotions, advanced methods such as text embedding, cosine distance calculation, and spectral density algorithms can accurately identify complex emotions in an unsupervised manner<sup>[35]</sup>. Furthermore, entity extraction algorithms<sup>[27]</sup> are employed to generalize and extract park elements. Based on satisfaction scores and complex emotion analysis derived from text scoring models, specific factors affecting visitors’ emotions and satisfaction are uncovered.

**Table 2: Algorithms and their application characteristics in park service effectiveness evaluation**

Category	Model	Description	Source
Text-based	Text embedding algorithm	Use the Text2Vec algorithm to map text into a vector space, quantifying semantic features; support similarity calculation, clustering, and sentiment analysis, enabling the park satisfaction assessment with comment texts	Ref. [25]
	Text classification algorithm	Utilize the DeBERTa model to classify textual data according to predefined labels; applied to complex sentiment prediction and refined sentiment annotation of park comment texts	Ref. [26]
	Text-named entity recognition algorithm	Employ the UIE (Unified Information Extraction) algorithm to extract specific elements of designated categories from structured texts; used for statistical analysis of designated categories in park comment texts	Ref. [27]
Visual	Object detection algorithm	Use supervised learning with the YOLOv8 model to detect and categorize objects in images, applied to the identification of common park elements; alternatively, the EfficientTeacher algorithm is used for semi-supervised YOLOv8 object detection of limited-sample elements	Ref. [28]
	Multi-modal detection algorithm	By leveraging the DINOv2 model’s general visual representations and its image–text semantic alignment capabilities, zero-shot detection of uncommon elements in park environments can be achieved without additional supervision	Ref. [29]
	Image segmentation algorithm	Implement image semantic segmentation to predict the pixel locations of park elements in images; for example, the OneFormer model is applied to compute the green view index, sky visibility, and the coverage of other elements in park images	Ref. [30]
	Image classification algorithm	Based on predefined criteria, the ConvNeXt-V2 model is used to classify park images and perform tasks such as image rating and blur understanding; applied to evaluation categories such as landscape, architecture, and sanitation	Ref. [31]
Others	Power spectral density	Analyze the spectral distribution of transformed text, enabling automated topic monitoring; applied to the satisfaction assessment with park comment texts	Ref. [32]
	Random Forest	Primarily used for index weight importance analysis	Ref. [33]
	Route planning algorithm	Analyze the accessibility of spatial targets; applied to the evaluation of park accessibility and service radius	Ref. [34]



2. Analysis of visitors' satisfaction level with specific park elements through text algorithms.

For visual indicators, image data constitutes an important source for evaluation<sup>[36][37]</sup> and can be amalgamated with deep learning algorithms to compute indicators across scales. The EfficientTeacher algorithm and the Yolov8 model<sup>[28][38]</sup> form the basis of this study, enabling model training with limited samples to identify common targets such as vacant parking lots and barrier-free facilities. Additionally, Zero-Shot algorithms are employed to recognize uncommon targets<sup>[29]</sup>. Segmentation models based on Transformer algorithms are applied to compute indicators such as green view index and sky visibility. In comparison to CNN models, which demonstrate proficiency in processing high-frequency data, Transformer-based models can better capture local features of streetscapes, rendering them more appropriate for complex environments such as parks<sup>[39]</sup>. Then, the final results of all calculated indicators are formed, providing data support for the generation of subsequent reports (Fig. 3).

## 3.2 Deficiency Diagnosis and Optimization Recommendation Generation

### 3.2.1 Generation of Park Impressions

With the text-based algorithms, a frequency analysis of keywords in park review texts is undertaken to catalogue high-frequency lists pertinent to individual parks. The lists are then used to generate park impression word clouds, forming a preliminary visualization of the differences among visitors' focus across parks. To further refine the park impressions, lexicons of high-frequency words (e.g., emotions, seasons, etc.) from all parks are constructed. The text data of visitor reviews for each park are statistically analyzed and categorized by word frequency, and the words ranking top 10 were selected as keywords. By integrating word frequency and the weight of high-frequency words, the score of each keyword can be calculated. Higher-score words are then taken as the core

descriptors for generating park impressions and are matched with their respective categories to summarize the preliminary impressions. Finally, these impressions are polished using LLMs to generate more sophisticated statements, such as "happiness is the dominant emotion associated with XX Park" or "autumn is the most popular season for tourists to XX Park."

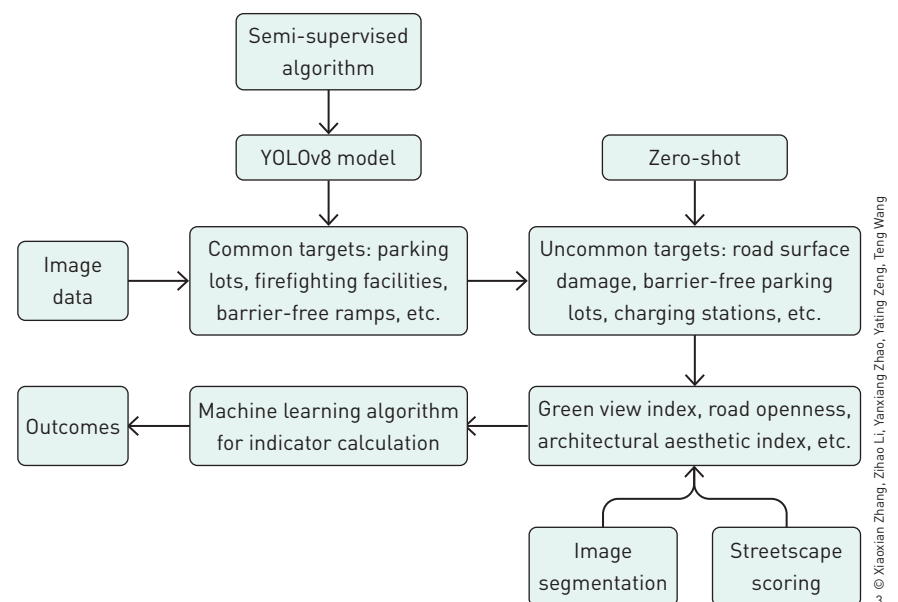
### 3.2.2 Deficiency Diagnosis

The park service effectiveness of individual parks can be ranked by their scores of each indicator, and assessed as levels of superior, average, or underperforming according to their rankings. In addition, the deficiencies of individual parks can be diagnosed by the trends of single indicator results over a given time span. Besides, indicators with established evaluation criteria (e.g., park capacity utilization, restroom density) can be assessed or rated by whether the park met the required benchmarks. It is important to note that, given the inherent differences among varied park types, deficiency diagnosis only conducts comparisons among parks of the same type, and evaluates each park's relative strengths and weaknesses based on its rankings for specific indicators.

### 3.2.3 Generating Optimization Recommendations

The generation of optimization recommendations for enhancing park service effectiveness is contingent upon the utilization of knowledge graph technology, which facilitates the connections between indicators, policies, and responsible entities. In comparison to unstructured text data, knowledge graphs, as

3. Image processing flow of visual algorithms.



a structured representation form of knowledge, are capable of describing concepts and their interrelations. The integration of knowledge, data, and their interrelations into a large-scale semantic network enables knowledge graphs to facilitate faster application in computation, interpretation, evaluation, as well as knowledge retrieval and reasoning. The ability of knowledge graphs to effectively process complex network structures renders them particularly well-suited to the generation of optimization recommendations for enhancing park service effectiveness<sup>[40]</sup>.

Specifically, indicator graphs standardize attributes such as indicator name, definition, hierarchy, and source, and generate a network that maps the relationships between indicator–data entities and indicator–indicator entities. This achieves the integration of the indicator system with multi-sourced data. Policy graphs adopt publicly available policy documents and provisions related to specific indicators as the basis for optimization recommendations. The graph further extracts keywords from policy texts as representations of policy content, and frequently co-occurring keywords are then linked to the same thematic nodes, enabling the semantic decomposition of policy texts and the representation of relationships among associated policies. Responsibility graphs delineate the entities charged with specific implementation tasks and establish a network connecting indicators, leading entities, responsible entities, task details, and authority bases.

Finally, the “indicator–policy–responsibility” knowledge graphs are matched with the relatively weaker indicators to establish linkages between relevant policy texts and responsible entities and produce detailed, textual optimization recommendations, with the aid of text generation technology.

### 3.3 Report Generation and Decision-Making

#### 3.3.1 Dynamic Batch Generation of Reports

In practice, evaluation results, deficiency diagnoses, and optimization recommendations are often presented in the form of reports. However, the generation of a substantial number of reports for numerous individual parks using conventional methods necessitates considerable human labor. This study proposes an automatic approach to generating park evaluation reports in batches by using templates and intelligent methods (Fig. 4). Templates see advantages in high standardization and efficiency, but most existing templates have insufficiency in precision and flexibility when addressing complex tasks<sup>[41]</sup>. Under the proposed framework, LLMs are integrated with report templates to enhance the flexibility, specificity, and readability of the generated reports.

#### 3.3.2 Intelligent Q&A Service

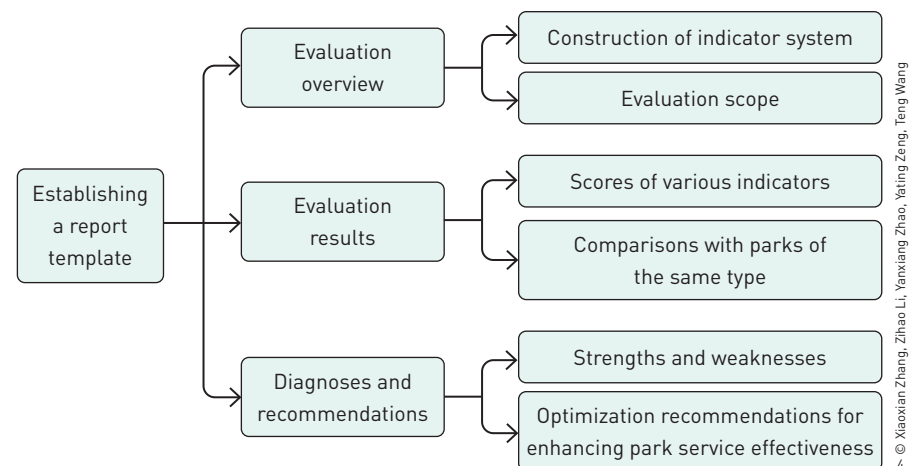
To more effectively address park managers’ actual needs in the decision-making process, a more user-friendly, efficient, and customized interaction method is provided through a Q&A manner. First, a suitable general-purpose LLM is selected for Q&A training, in conjunction with the construction of a localized knowledge base for the enhancement of park service effectiveness, which encompasses basic park information, facility descriptions, activity schedules, evaluation results of different indicators, and reports. To address the issues of inaccurate content generation, isolated combination of knowledge base, and difficulties in representing interrelations due to insufficient understanding of context, the research team introduced a knowledge-first preference alignment method, which integrates embedding models, rule-based templates, and recommendation algorithms to retrieve relevant information from the knowledge base, and realizes a Q&A service system that provides accurate and detailed responses tailored to park service effectiveness.

## 4 Empirical Research on the “Evaluation–Diagnosis–Decision-making” Framework for Park Service Effectiveness Enhancement

### 4.1 Research Overview

Beijing Municipality has been conducting park service effectiveness evaluations since 2022. The evaluations cover the seven types of parks outlined in the Beijing Park Classification and Management Measures (revised in 2022), including comprehensive parks, community parks, historical gardens, specialized parks, recreational gardens, ecological parks, and natural parks. By the end of 2023, evaluations for a total of 364 parks across all districts

4. Automatic generation of park evaluation reports in batches by using templates.



in the city have been completed by employing the “evaluation–diagnosis–decision-making” framework proposed in this paper, realizing evaluations of park service effectiveness at different time periods and informing decision-making for park service effectiveness enhancement at the city scale.

## 4.2 Application Process

### 4.2.1 Construction of Evaluation Indicator System

The research team initially conducted an analysis of citizens’ demands, and then constructed a preliminary evaluation indicator system of park service effectiveness, drawing on the connotation of park service effectiveness and relevant domestic and international research<sup>[11][42]~[44]</sup>. Afterward, the research team examined the

data quality and update status gathered by park management authorities of the city, as well as the quality of available social perception data and active sensing data. From the perspectives of indicator computation feasibility and data update sustainability, an evaluation indicator system was finally constructed, which includes two main categories, 4 primary indicators, 12 secondary indicators, and 26 tertiary indicators (Table 3). Different types of parks vary in terms of indicator selection and weight setting.

### 4.2.2 Generation of Park Impressions

The research team developed 10 lexicons, namely “Park Name,” “Entrance and Exit,” “Time,” “Mood,” “Activity,” “Natural Landscape,”

**Table 3: Park service effectiveness evaluation indicator system**

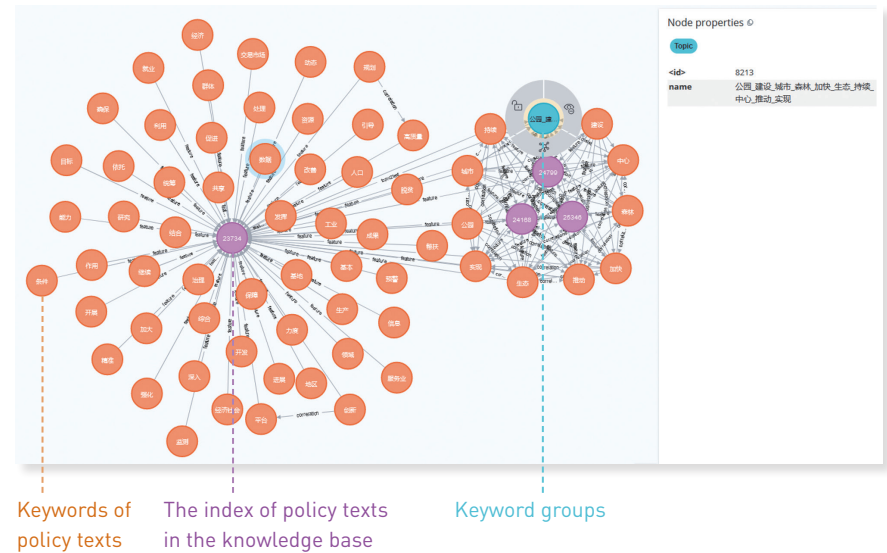
Category	Primary indicator	Secondary indicator	Tertiary indicator	Category	Primary indicator	Secondary indicator	Tertiary indicator	
Service effectiveness	Attraction to tourists	Popularity	Weekday tourist index	Resource investment	Resource and facility	Service facilities	Signage coverage	
			Weekend/holiday tourist index				Toilet availability	
		Tourist attraction intensity	Visit distance index				Barrier-free facilities	Barrier-free toilet availability
			Stay duration index					Barrier-free path quality
	Tourist satisfaction	Landscape satisfaction	Natural landscape satisfaction index			Management facilities	Management building configuration	
			Cultural landscape satisfaction index				Operation and maintenance	Path cleanliness
		Service management satisfaction	Safety and management satisfaction index			Sanitation		Water quality of waterbodies
			Cultural and educational service satisfaction index				Safety	Surveillance system configuration
	Visitor complaint index	Emergency facility configuration						
	Resource investment	Resource and facility	Green space resource			Greening coverage	Online operation	Safety
Recreational facilities				Fitness facility availability	Online service frequency			
			Service facilities	Playground facility availability	Online service impact			
Parking availability								

“Cultural Landscape,” “Amusement,” “Service,” and “Sports and Fitness.” These lexicons were used to generate impressions for each park. For example, “camping” is the most mentioned activity at the Grand Canal Forest Park; “boating” is the most popular amusement at Taoranting Park; and “sunflowers” are the favorite natural landscape at Olympic Forest Park. These park impressions reflect the alignment between the park service effectiveness with visitors’ needs, offering park managers a reference for improvement directions.

#### 4.2.3 Deficiency Diagnosis and Optimization Recommendation Generation

After computing the indicators, park managers can view the overall ranking of park service effectiveness across the city, the ranking of specific indicators, and strengths and weaknesses of individual parks. By utilizing “indicator–policy–responsibility” knowledge graphs, optimization recommendations were generated based on the park’s weaker indicators. Figure 5 shows an example of a policy graph, where orange nodes representing keywords of policy texts, blue nodes for keyword groups, and purple nodes for the index of policy texts in the knowledge base.

The research team integrated the relative strength and weakness indicators, deficiency diagnoses, and corresponding optimization recommendations into a standardized report (Fig. 6), enabling park managers to quickly and clearly understand how to translate indicator results into actionable plans. The research team developed an engine for report template design, which, through built-in intelligent diagnostic logic and configurable generation cycles, can automatically and regularly produce reports, ensuring the continuity of park service effectiveness monitoring. During the report generation, the system integrated a Transformer-



5. An example of policy knowledge graph.
6. Optimization recommendations for a park’s weaker indicator (e.g., safety maintenance).

based language model to perform in-depth analysis and polish the initial report upon the template to improve its readability and professionalism. The final reports, which were refined and more concise, were formulated in formats such as PDF and Word, making it easy for users to access, edit, and share via various platforms and devices.

For the intelligent Q&A service, the research team built a localized knowledge base for park service effectiveness by Chatglm3, a fine-tuned open-source general LLM, combined with urban governance-related datasets. This knowledge base was then embedded into the front-end page of the park management system, allowing managers to easily and conveniently access

Optimization Recommendation 2: Safety Maintenance ★★★★★

Third-level Indicators to Focus on : Tourist Safety Capacity Surveillance System Configuration

Authorities : Districts Bureau of landscaping of Beijing Municipal Beijing Municipal Forestry and Parks Bureau

Specific measures : According to the Three-Year Action Plan for the Construction of Boundless Parks in Beijing (2023-2025), ensuring the safety of park visitors and resources is the prerequisite and foundation of park service management. Parks should, according to the needs of security management, set up multifunctional identification type video monitoring (such as night vision...)

View More...
Map View

Authorities : Districts Bureau of landscaping of Beijing Municipal, Beijing Municipal Forestry and Parks Bureau  
According to the Three-Year Action Plan for the Construction of Boundless Parks in Beijing (2023-2025), ensuring the safety of park visitors and resources is the prerequisite and foundation of park service management. Parks should, according to the needs of security management, set up multifunctional identification type video monitoring (such as night vision, smoke and fire detection, call, etc.), pRRU and other equipment to enhance the level of monitoring of park tourist flow and safety and technical defence. Parks suitable for nighttime tours should scientifically plan tour routes and reasonably set up nighttime lighting and safety signs in the parks, increase inspections and guards, and strictly prevent all kinds of accidents.

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Authorities : Municipal Agencies, The People’s Government of Beijing Municipal, Municipal Government Bureaus, Municipal Government Offices, Municipal Government Committees  
According to the Beijing ‘14th Five-Year Plan’ period major infrastructure development plan, to promote intelligent management of parks, real-time aggregation of visitor volume, analysis and judgement, diversion scheduling, intelligent warning.

[Policy Download](#)

Authorities : City-owned Forestry Unit ,Beijing Municipal Forestry and Parks Bureau, Districts Bureau of landscaping of Beijing Municipal  
According to the Beijing Municipal Standards for the Construction and Management of Parks in Green Isolating Areas (for Trial Implementation), alarm facilities such as sirens and fire alarm telephone signs should be provided, as well as security measures such as public security monitoring systems, broadcasting and alarm systems, public security pavilions and security guardrails.

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decision-making knowledge related to park service effectiveness (Fig. 7).

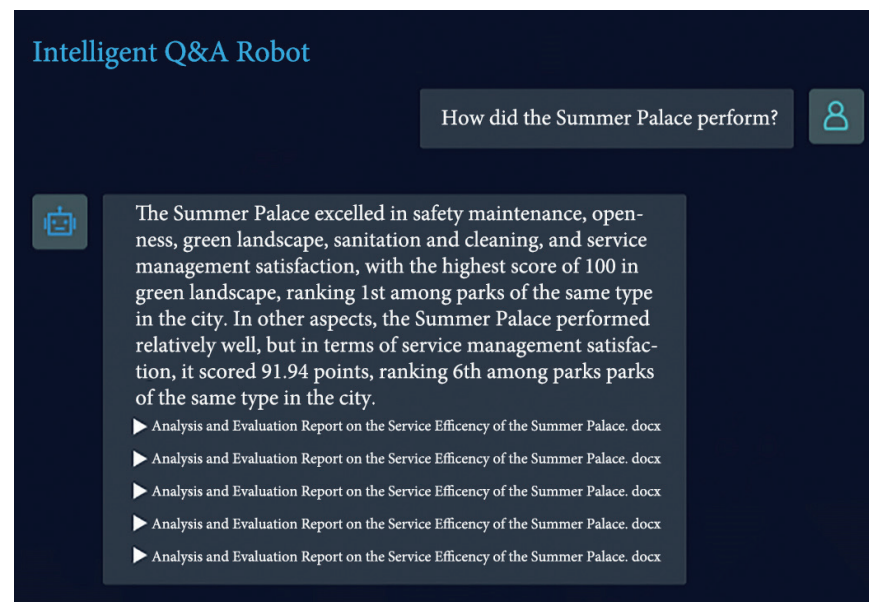
### 4.3 Application Effectiveness

In Beijing's evaluations of park service effectiveness, the method proposed by the research team has enabled a comprehensive and in-depth assessment of park service effectiveness from a city-wide perspective. This has effectively overcome the conventional limitations like single-category focus, lack of continuity, and insufficient application support. Currently, the evaluations have not only become one of the key tasks for the Beijing Municipal Forestry and Parks Bureau in promoting the Garden City construction, but also facilitated park management through continuous and precise tracking of park service effectiveness. Taking the Central Green Forest Park as an example, in the third quarter of 2023, the park was diagnosed as "underperforming" in terms of operations and maintenance. Thereby the report recommended the park to improve its sanitation and cleanliness. Through an overall inspection of all the sanitation indicators, the park improved its path cleanliness service effectiveness by 4.5% in the fourth-quarter evaluation of the same year.

## 5 Conclusions

This paper reviews the connotation of park service efficacy, identifies deficiencies in actual operation through investigations and surveys, and proposes a framework for enhancing park service efficacy that is innovative both in terms of process coverage and the integration of technological applications. This framework excavates multi-sourced data and applies intelligent algorithms to swiftly generate reports, containing a multitude of evaluation indicators, deficiency diagnoses of individual parks, and optimization recommendations, facilitating the extensive deployment of refined park service effectiveness evaluation. In addition, this framework can also take into account the actual demands of park managers, and provide Q&A service to better assist them in converting optimization recommendations into action plans. This has been applied in the work of enhancing park service effectiveness in Beijing and achieved remarkable results.

With the continuous increase in the public's demand for enhancing park service effectiveness, this paper attempts to expand related research and to provide new insights and paths for bridging the gap between academic outcomes and the practical application of decision-making in park management. Follow-up research, on the one hand, should further improve the evaluation



7. An example of intelligent Q&A service.

workflow and explore closed-loop solutions integrating planning, design, construction, and operation. On the other hand, it is essential to continuously deepen the level of technology integration in each application step—e.g., the continuous optimization of the base model, the construction and retrieval of the knowledge base—to generate more refined deficiency diagnoses and optimization recommendations. In addition, researchers should also consider how to introduce geographical and spatial concepts into language models, so as to improve the accuracy of Q&A service and to respond to diverse geographical and spatial requests, promoting its effectiveness and applicability.

**Competing interests** | The authors declare that they have no competing interests.

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# 新技术支持下的城市公园服务效能提升方法建构

张孝贤<sup>1</sup>, 李梓豪<sup>2</sup>, 赵艳香<sup>2</sup>, 曾亚婷<sup>1</sup>, 王腾<sup>1,\*</sup>

<sup>1</sup> 北京城市象限科技有限公司, 北京 100027

<sup>2</sup> 北京市园林绿化大数据中心, 北京 101118

\*通讯作者

地址: 北京市东城区珠市口东大街甲16号天鼎218文化

金融园B12-13

邮编: 100027

邮箱: wangteng@urbanxyz.com

## 图文摘要



## 摘要

有效提升公园服务效能是推进公园城市建设的重要途径。然而, 现有公园服务效能研究中存在评估对象与管理需求错位、从评估到诊断建议的精准延伸不足、研究成果时效性与持续性较差等问题, 无法对公园管理者的服务效能提升决策提供足够支持。本研究从全工作流程出发, 提出新技术支持下的公园服务效能“评估 - 诊断 - 决策”方法: 首先, 利用多源数据拓展公园服务效能的感知维度, 结合智能算法支撑效能指标评价; 其次, 构建知识图谱提供精准诊断建议; 最后, 通过模板与智能技术自动生成报告, 并引入大语言模型支持下的问答查询, 从而精准提升公园服务效能的评估、诊断和决策能力。文章以北京市公园服务效能评估相关工作作为实证案例, 验证了本方法的良好实际应用效果, 可以为城市公园管理服务优化提供新的视角和可操作工具。

## 关键词

公园服务效能; 公园管理; 管理决策; 多源数据; 知识图谱; 大语言模型

## 文章亮点

- 通过智能算法精准识别公园具体问题并提供解决对策
- 构建知识图谱, 延伸评估结果到公园管理策略的工作流程
- 自动化报告生成, 提升公园服务效能评估报告的有效性
- 引入大语言模型问答查询, 低成本精准提升公园服务效能的评估、诊断和决策能力

编辑 田乐, 高雨婷

## 1 研究背景

城市公园绿地是城市中重要的公共资源，与公共健康、生态环境质量、社会福祉等紧密相关<sup>[1]</sup>。然而，面对新的社会发展需求，尤其是在各地兴起“公园城市建设”“森林城市建设”的背景下，如何提升公园服务效能以推动城市存量发展，已成为公园管理者必须面对的工作难题<sup>[2]</sup>。目前，大数据和人工智能等新技术的快速发展和广泛应用为公园服务效能提升提供了契机。基于此，本研究聚焦新技术在公园服务效能“评估—诊断—决策”框架的全流程应用探索，旨在构建一套面向公园实际管理的服务效能提升方法。

## 2 文献综述

“效能”（effectiveness）为管理学术语。现代管理学之父彼得·德鲁克认为，效能是指选择适当的目标并实现目标的能力<sup>[3]</sup>。中国学者一般将效能的内涵拆解为“效”（作用效果）和“能”（能力）两部分<sup>[4][5]</sup>。参照效能内涵的已有研究<sup>[6]</sup>，本文将“公园服务效能”定义为公园的服务效果和公园管理者的服务能力。提升公园服务效能首先需要对已有服务效果和服务能力进行评估，同时将评估结果转化为管理者的决策。这需要科学的公园服务效能评估体系、高效的评估技术，以及评估结果的有效应用，即决策传导路径。

在评估体系方面，有研究将公园效能分为生态效能、经济效能、社会效能和综合效能四类，并对每类效能的评估内容进行了总结<sup>[7]</sup>。在评估尺度方面，宏观层面评估关注城市公园的可达性、分布均衡性、活力等<sup>[8]-[10]</sup>，微观层面评估则聚焦某一类公园或个体公园，重点关注游客量、游览满意度、设施投入等内容<sup>[11][12]</sup>。在评估技术上，无人机遥感、文本分析、地理空间分析和大数据技术等已有较广泛的应用<sup>[13]-[16]</sup>，传统的统计台账数据、问卷调查数据、遥感数据与新兴的互联网地图数据、手机信令数据、舆情数据等均已应用于各类效能评估研究<sup>[17]-[19]</sup>。在评估应用上，尽管有部分学者面向管理诉求，研究了如何将评估结果背后的责任传导至相关职能部门<sup>[20]</sup>，但这些研究在评估后提出的策略性建议详尽不一。

总体而言，现有研究可以为公园服务效能提升决策提供不同角度的支撑，但大部分研究都重评估轻应用，决策传导路径建设相对薄弱，具体表现为以下三类问题。第一，研究对象和公园管理的实际对象存在一定错位。目前的研究内容多聚焦于某一类城市公园的服务效能，且提供的多为总体策略性建议，而忽视了公园日常管理中公园个体具体问题的精准识别和针对性解决对策的需求。第二，现有研究多聚焦于单一效能类别，所采用的数据大多难以兼顾全面和精细的要求。第三，实际公园管理强调时效性和持续性，但现有研究成果多为孤立的课题，其有效性也存在一定的滞后，且鲜有就如何在成本控制下持续提供决策支持的探讨。

针对传统技术手段和方法的不足，本研究从公园服务效能提升的全工作流程出发，提出新技术支持下的公园服务效能“评估—诊断—决策”框架。本方法创新性地融合了多项新技术，可实现对公园服务效能的全面感知，精准形成诊断方案和优化建议，并助力公园管理者将这些信息有效地转化为各项行动计划。

## 3 公园服务效能“评估—诊断—决策”方法建构

本文提出的公园服务效能“评估—诊断—决策”方法如图1所示。“评估”作为该方法的首要环节，先对常用数据，尤其是各类主动感知数据进行数据感知监测；其次，借助文本算法、视觉算法等智能算法构建服务效能指标并加以计算。在“诊断”环节，根据主观诊断生成公园印象、根据各指标计算结果诊断出公园的优劣势，并基于知识图谱技术将指标及其事权主体、相关政策进行关联，精准生成公园具体效能优化建议。在“决策”环节，面向公园实际管理场景，基于模板和智能化技术自动生成周期性评估报告，并通过大语言模型将评估报告及相关知识整合，同时构建智能问答服务，为公园管理者提供决策便捷查询功能。

### 3.1 公园服务效能感知与计算方法

#### 3.1.1 公园服务效能感知的多源数据

为了尽可能全面涵盖公园服务效能感知数据，本文对目前常用的评估数据进行了分类<sup>[21]</sup>（表1）。其中，公园管理数据是指公园运营、环境、游客等方面的数据；社会感知数据是指利用现代信息技术手段收集的大量具有时空标记的数据，这类数据具有覆盖广泛、更新迅速等特点，有效弥补了对新兴公园使用行为和场景（如“城市漫步”等）感知的不足<sup>[21]</sup>；主动感知数据是指有针对性地采集到的精细化公园建成环境感知数据，通过算法分析，可用于识别公园无障碍、户外健身等设施的破损和缺失问题。多源数据的引入和组合使用可为公园服务效能挖掘提供充分支持。

#### 3.1.2 指标智能算法

本文并未从方法论层面建立一套公园服务效能通用指标体系，而是认为指标体系应基于具体评价对象灵活设置、调整，并借助智能算法实现大范围、精细化的效能指标计算<sup>[22]-[24]</sup>。本文将智能算法分为文本类、视觉类和其他类<sup>[25]-[34]</sup>（表2），并重点对前两类算法的应用特点进行说明。

在文本类指标计算方面，可以通过文本算法挖掘游客对公园具体要素的满意度（图2）。相较于过去仅能实现正负情绪的简单分类，通过文本嵌入、余弦距离计算及谱密度算法的方法，能够在无监督的情况下，更为精准地识别复杂情感<sup>[35]</sup>。最后，通过实体抽取算法<sup>[27]</sup>，完成对公园要素的泛化抽取，并综合文本评分模型计算得到的满意度和复杂情绪评

表 1: 公园服务效能评估常用数据分类

类型	代表数据	数据内容	应用价值	限制
公园管理数据	空间位置数据	公园名称及空间位置信息	公园分布评估的基础数据	—
	台账数据	公园管理情况的记录, 包括公园类型、面积、管理主体、绿化率、树木数量、园路长度、无障碍设施(分布、数量、类别、检修日期)等信息	包含公园设施、服务、管理等方面的基本信息, 可用于公园服务效能多方面评价	一般以年度为单位进行统计, 数据更新慢
	定点环境监测数据	温度、湿度、风力、空气质量等信息	可用于公园环境评价	依赖传感器布局, 精度有限
	园林监测数据	地下水位、土壤墒情、植被长势、病虫害等信息	可用于公园环境评价	依赖传感器布局, 精度有限
	居民诉求数据	来自 12345 和其他诉求渠道的各类投诉、建议和咨询数据	具有空间和时间精度高的特点, 可以自下而上地反映公园服务效能	数据获取全面性及数据处理技术要求高
社会感知数据	POI 数据	公园出入口、内部及周边设施的名称、位置	可用于分析公园设施可达性和覆盖情况	数据可能存在误差, 需要清洗校正
	住区数据	公园覆盖住区的名称、户数、建成年代、建筑面积、房价等信息	可用于分析公园覆盖度与人口分布匹配情况	住区人口与公园实际使用人口可能存在误差
	手机信令数据	基于手机定位数据得到的客流量、客流结构、客流来源等信息	可用于分析公园客流量、全龄友好性等	数据获取成本高
	评论数据	游客在公园官方线上平台上发布的评论、评分等信息	可用于测度公园满意度、提取公园印象等	数据分析技术要求高
	活动数据	公园活动的名称、类型、时间、规模、传播情况等信息	可用于分析公园运营活力	仅针对线上发布活动, 未覆盖所有公园活动
	社交媒体数据	社交媒体上关于公园的发布内容及其阅读量、点赞/评论量等信息	可用于评估公园的社会影响力	代表性有限, 多来源获取难度大
主动感知数据	全景照片	全景照片及其拍摄时间、位置等信息	结合计算机视觉技术, 用于识别、评价公园设施分布、公园服务品质等情况	数据分析技术要求高
	路面颠簸度数据	不同时间和地点的路面颠簸度数据	可用于分析公园无障碍建设情况	需要硬件设备支持
	环境移动感知数据	温度、湿度、空气质量、异味、噪音及相应时空信息	可用于全面、精细化评价公园环境品质	需要硬件设备支持
	调查访谈数据	基于特定目的采集到的专项信息	可用于公园各个维度的深入分析评估	人力成本高, 难以大规模推广

注

社会感知数据相关内容来源: 参考文献 [21]。

价, 挖掘影响游客情绪与满意度的具体因素。

在视觉类指标方面, 针对图像数据这一重要的评价数据来源<sup>[36][37]</sup>, 可结合深度学习算法进行不同尺度内的指标计算。本研究基于

EfficientTeacher算法思想、结合YOLOv8模型<sup>[28][38]</sup>, 实现少样本的模型训练, 并对停车位空置、无障碍设施等常见目标进行检测; 另一方面, 利用Zero-Shot算法对不常见目标进行识别<sup>[29]</sup>。此外, 研究采用基于

表 2: 公园服务效能评价中的智能算法及其应用特征

类型	算法模型	应用说明	来源
文本类	文本嵌入算法	通过 Text2Vec 算法将文本映射至向量空间, 量化其语义特征, 为相似度计算、聚类和情感分析提供基础, 从而完成公园评论文本满意度分析	Ref. [25]
	文本分类算法	利用 DeBERTa 模型将文本数据按照指定标准进行分类, 应用于公园评论文本复杂情绪判别及精细化满意度评分	Ref. [26]
	文本实体抽取算法	使用 UIE 算法抽取文本中指定类别的具体要素, 应用于公园评论文本所涵盖的指定类别要素统计	Ref. [27]
视觉类	目标检测算法	通过全监督训练 YOLOv8 模型检测出图像中的指定类别要素, 应用于公园常见要素检测; 或结合 EfficientTeacher 算法实现半监督 YOLOv8 的少样本要素检测	Ref. [28]
	多模态检测算法	利用 DINOv2 模型的通用视觉特征和文本语义对齐能力, 在无需额外监督信息的前提下, 实现对公园不常见要素的 Zero-shot 检测	Ref. [29]
	图像语义分割算法	像素级语义分割可预测图像指定要素的像素位置, 例如 OneFormer 模型可应用于公园绿视率、天空等要素占比的计算	Ref. [30]
	图像分类算法	将图像按照指定要求进行分类, 通过 ConvNeXt-V2 模型实现公园图像的评分、模糊理解等任务, 应用于公园景观、建筑、卫生等指标评分	Ref. [31]
其他类	谱密度算法	将嵌入后的文本向量聚类分析, 可实现文本无监督分类, 应用于公园评论文本要素满意度计算	Ref. [32]
	随机森林算法	主要应用于指标权重分析	Ref. [33]
	路径规划方法	用于解决空间目标点的可达性分析, 应用于公园可达性和服务覆盖范围分析	Ref. [34]

Transformer算法的分割模型来计算绿视率、天空可见度等指标。相对于擅长处理高频数据的CNN模型, 基于Transformer算法的模型能够较好地捕捉街景的局部特征, 更适用于公园环境等复杂场景<sup>[39]</sup>。最后, 对各项指标进行汇总计算, 形成最终结果, 进而为生成下游报告提供数据支持(图3)。

### 3.2 问题诊断与优化建议生成

#### 3.2.1 公园印象生成

在前文所述文本类算法基础上, 首先统计公园评论文本关键词的词频, 形成各个公园的高频词表, 随后, 生成公园印象词云, 以初步呈现各个公园的游客关注点差异。进而基于所有公园高频词构建公园分类词库(如情绪类、时间类等), 对各个公园的游客评论文本数据进行词频统计和归类, 选取词频排名前10的词作为关键词, 并综合词频和高频词权重计算各个关键词的得分, 得分较高的词作为公园印象生成的核心并与词类匹配生成初步总结, 而后通过大语言模型润色生成公园印象。例如, “开心是XX公园的主要情绪” “秋天是XX公园游客最常到访的季节”。

#### 3.2.2 问题诊断

可针对各个公园服务效能评估指标评分对各公园进行排名, 并依据排名高低将公园评定为较好、一般和欠佳三个级别; 同时, 还可通过单个指标结果在一定时间跨度内的变化趋势诊断公园自身问题。此外, 可对部分具有评价标准的指标(如公园设计容量达成度、公厕密度等)是否达标进行判断或评级。考虑不同类型公园间的差异, 问题诊断部分仅对同类型公园进行了横向对比, 并通过某一指标的排名来评估每个公园的相对优劣势指标。

#### 3.2.3 优化建议生成

公园服务效能优化建议生成主要依靠知识图谱技术打通“指标—政策—事权”之间的关系。相较于非结构化的文本数据, 知识图谱作为一种结构化的知识表现方式, 可用于迅速描述知识概念及其相互关系, 能够将知识、数据及其关联关系聚合为大规模的语义网, 使得知识能够更快速地应用于计算、解释、评价, 以及知识的检索和推理。由于知识图谱技术对复杂网络结构的强大理解能力, 其天然适用于就公园服务效能的问题提出优化建议<sup>[40]</sup>。

其中, 指标图谱对指标的名称、含义、层级、来源等属性进行标准化整理, 并通过指标—数据实体关系和指标—指标实体关系生成指标图谱关系网络, 实现指标体系的整合和多源数据的融合。政策图谱是将指标相关的公开政策条文作为公园服务效能优化建议的依据, 通过提炼政策文本中的重要关键词作为该政策的内容表征, 再进一步将重复出现的关键词关联至同一主题节点当中, 从而实现政策文本的语义拆解和相关政策之

间的关联表示。事权图谱是为了明确工作落实主体，并构建各相关指标、牵头单位、相关责任单位、事权内容、事权依据等内容的关系网络。

最后，将指标—政策—事权知识图谱与公园的相对劣势指标进行匹配，以链接相关的政策条文和实体责任单位，并结合文本生成技术形成具体文字性建议。

### 3.3 报告和决策方法生成

#### 3.3.1 报告的批量动态生成

在实际应用中，效能评估指标结果、问题诊断和优化建议往往以报告的形式呈现。然而，采用传统方法批量生成公园个体报告需要耗费巨大的人力成本。本文提出通过利用模板和智能化的综合方法，实现公园评估报告的自动批量生成（图4）。模板具有规范化、效率高的优势，但现有模板大多精细度较低，且在应对复杂问题时灵活性差<sup>[41]</sup>。因此，本文提出在报告模板的基础上引入大语言模型，以提升报告内容的灵活性、针对性及可读性。

#### 3.3.2 智能问答查询

为了更好地满足公园管理工作者在决策过程中的实际诉求，可通过问答对话的方式向他们提供一种更为友好、高效、定制化的交互方式。首先，选取合适的通用大语言模型进行问答训练，然后建立公园服务效能本地知识库，包括公园的基本信息、设施介绍、活动安排等内容，以及各类指标评估结果和报告。同时，为解决大语言模型在处理复杂问题时缺乏足够上下文和深度理解而导致的生成内容不准确、知识库中知识孤立、关联性难以表征等问题，研究团队引入基于知识优先的偏好对齐方法，并结合嵌入模型、规则模板及推荐算法等来召回知识库中的相关信息，实现了精细化的公园服务效能问答反馈。

## 4 公园服务效能提升方法实证研究

### 4.1 研究概况

北京市自2022年起连续开展了公园服务效能评价工作，评价对象涵盖了《北京市公园分级分类管理办法》（2022年修订）中提出的综合公园、社区公园、历史名园、专类公园、游园、生态公园、自然（类）公园7类，截至2023年底评估全市各区公园共计364个。在实际工作中，北京市基于本文提出的公园服务效能“评估—诊断—决策”框架，完成了多个时间截面的公园服务效能评估，支持了全市公园服务效能提升决策工作。

### 4.2 应用过程

#### 4.2.1 构建评估指标体系

研究团队首先基于北京市居民诉求数据进行需求分析，并结合

公园服务效能内涵及国内外相关研究初步构建公园效能评估指标体系<sup>[11][42]-[44]</sup>。而后，研究团队调研了园林管理部门所掌握的数据质量及更新情况，评估了可获取的社会感知数据和主动感知数据的质量，最终从指标计算可行性、数据更新维持性的角度构建了公园效能评估指标体系，包含两大类、4个一级指标、12个二级指标和26个三级指标（表3）。不同类型的公园在指标选取和权重设置上有所差异。

#### 4.2.2 公园印象生成

研究团队按照公园印象生成方法，构建了“公园名称”“出入口”“时间”“心情”“活动”“自然景观”“人文景观”“游乐项目”“服务项目”“运动健身”共10个词库，进而形成了各个公园印象。例如，“露营”是大运河公园游客提及最多的活动，“划船”是陶然亭公园最受欢迎的游乐项目，“向日葵”是奥森公园游客最喜欢的自然景观等。这些公园印象直观地展现了各个公园服务效能与游客需求的契合度，为公园管理者提供了改进方向参考。

#### 4.2.3 问题诊断与优化建议

在指标计算完成后，公园管理者可以查看全市公园服务效能总体排名、某一指标排名，以及公园个体优劣势指标分析。借助指标—政策—事权知识图谱与公园的相对劣势指标的匹配结果生成优化建议。例如，图5为本研究构建的部分政策图谱，其中橙色为政策文本关键词，蓝色为关键词组，紫色为政策文本在数据库的索引。

研究团队将相对优劣势指标、问题诊断与相应的优化建议整合并形成规范化的报告（图6），供公园管理者清晰、快速了解如何将指标结果有效转化为行动计划。研究团队在报告模板设计中开发了报告引擎，通过内置智能诊断逻辑和设置报告生成周期，可定期自动生成报告，从而确保服务效能监测的持续性。在报告内容的生成过程中，系统接入基于Transformer的语言模型基座，对模板生成的初步报告进行深度分析和润色，以提升报告的可读性和专业性。经过智能化处理的报告不仅在语言风格上更加贴近人类的表达习惯，在内容上也更加精练扼要。最终生成的报告支持PDF、Word等格式，方便用户在不同的平台和设备上进行查阅、编辑和分享。

在智能问答功能中，研究团队以开源通用大语言模型Chatglm3为基础，依据城市治理相关数据集进行微调，构建公园服务效能本地知识库，并最终形成问答机器人嵌入公园管理系统前端页面，方便管理者在公园服务效能相关工作中随时便捷地获取决策知识（图7）。

### 4.3 应用成效

在北京市公园服务效能评估相关工作中，研究团队提出的公园服务效能提升方法实现了从全市层面对公园服务效能情况的全面且深入的评

表 3: 公园服务效能评价指标体系

评估类别	一级指标	二级指标	三级指标	
服务效果类	游客吸引度	游览热度	工作日游客到访指数	
			节假日游客到访指数	
		游客吸引强度	游客来访距离指数	
			游客停留时长指数	
			游客满意度	自然景观满意指数
	游客满意度	景观满意度	人文景观满意指数	
			安全管理满意度	安全管理满意指数
		服务管理满意度	文化科普服务满意指数	
			公园游客诉求指数	
			资源投入类	资源与设施
	资源与设施	游憩设施	健身设施供给水平	
			游乐设施供给水平	
		服务设施	停车设施供给水平	
			标识覆盖水平	
			厕位供给水平	
	无障碍设施	无障碍设施	无障碍厕位供给水平	
			无障碍道路水平	
	管理设施	管理用房配置		
	运营与维护	卫生保洁	卫生保洁	园路清洁水平
				水体清洁水平
安全维护			安全维护	监控系统配置
		应急设施配置		
线上运营		线上运营	游客安全承载度	
			线上运营	线上服务类型
				线上服务频率
	线上服务影响力			

估, 相较原来单一类别、缺乏持续性、应用支持不足的情况具有显著提升。目前, 相关评估工作不仅已成为北京市园林绿化局落实花园城市建设的重要工作之一, 也通过对公园服务效能的持续精准追踪, 为具体公园管理工作提供了支撑。以城市绿心森林公园为例, 2023年第三季度其在运营与维护方面被诊断为“欠佳”, 报告建议在卫生保洁等方面进行重点提升。随后, 该公园就卫生保洁下的各个指标进行了精准排查与改进, 在当年第四季度的评估中, 园路清洁水平指标提升了4.5%。

## 5 总结

本文对城市公园服务效能内涵进行了辨析, 通过调查发现了实际工作中存在的不足, 并基于此提出了一套公园服务效能提升方法, 在流程覆盖范围和技术应用融合方面均具创新性。该方法不仅挖掘了多源数据, 还引入了智能算法, 快速生成包含大量评估指标的报告, 并对公园个体问题进行诊断、生成优化建议, 进而支持精细化公园服务效能评估工作的大范围展开。此外, 该方法还可以结合公园管理者的实际诉求, 通过对话问答的形式, 更好地协助管理者将优化建议转化为行动计划。这一方法已在北京市公园服务效能提升工作中得到了应用, 并取得了较为显著的成果。

近年来, 随着公众对于公园服务效能需求的不断提升, 本文尝试对现有公园服务效能研究进行拓展, 为学术成果与实际管理决策应用的衔接提供了新思路和新路径。后续研究一方面需进一步完善公园服务效能评估流程, 探讨从策划、规划、设计、建设到运营一体化的闭环式整体解决方案; 另一方面需不断深化各个应用环节中的技术结合水平(例如, 模型基座的持续优化及知识库的构建与检索), 以生成更加精细化的问题诊断与优化建议。此外, 相关研究人员还应思考如何将地理空间概念引入语言模型, 在提高问答精度的同时支持空间问答等多样化需求, 提升问答系统的效能和适用性。

图 1. 公园服务效能“评估-诊断-决策”框架

图 2. 通过文本算法挖掘游客对公园具体要素的满意度

图 3. 通过视觉算法处理图像的流程

图 4. 基于模板的公园评估报告的自动批量生成

图 5. 政策图谱示例

图 6. 某公园劣势指标的诊断建议示意图(安全维护)

图 7. 智能问答示例