EXPLORING THE PATH OF INDUSTRIAL HERITAGE LANDSCAPE DIGITIZATION IN THE CONTEXT OF URBAN RENEWAL: A CASE STUDY OF BEIJING

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ABSTRACT
As globalization and urbanization accelerate, cities face land scarcity and the loss of cultural heritage. Industrial heritage—an essential component of urban history—requires innovative strategies for protection and reuse. Digital technologies such as 3D scanning, VR, AR, and GIS have transformed the documentation, management, and presentation of industrial heritage landscapes, creating both opportunities and challenges for conservation. This study explores digital strategies for preserving industrial heritage landscapes amid urban renewal, with a focus on enhancing public accessibility and engagement.

Focusing on Beijing's industrial heritage landscapes, this study adopts a "identification–analysis–construction" framework to investigate the integration of physical, social, and digital spaces. The identification stage uses literature review and GIS analysis to map and categorize landscape elements. The analysis stage examines land use transitions, transport links, and public engagement through spatial and perception data. In the construction stage, a digital platform is developed to enhance public accessibility and interaction, demonstrating the role of digital tools in participatory heritage planning.

Key findings include the development of a comprehensive database detailing the locations and conditions of Beijing's industrial heritage sites. The study analyzes their relationships with land use, transportation networks, and public engagement. It proposes digital strategies for both heritage managers and the general public, culminating in a user-friendly digital platform that enables historical exploration, interactive participation, and a stronger public connection to these sites.

In conclusion, this research establishes a scientific basis for the protection, adaptive reuse, and sustainable development of industrial heritage landscapes through digital technologies. It contributes to landscape architecture by presenting an integrative framework that bridges technological tools with participatory landscape planning. While limitations such as data completeness and varying levels of public engagement persist, the study offers a replicable model for other post-industrial urban regions seeking innovative approaches to heritage preservation and cultural landscape management.

Keywords
Industrial Heritage, Digital Landscape, Sustainable Development, Digital Interactive Platform, Value Realization

A substantially extended and updated version of this study has been published in Landscape Architecture and Sustainability (Liu et al., 2026). The journal article further develops the methodological framework, empirical analysis, and discussion presented in this conference paper.

1 INTRODUCTION

Amid globalization and rapid urbanization, cities face challenges including land scarcity, environmental degradation, and heritage loss (Zheng & Masrabaye, 2023). Urban renewal has emerged as a critical strategy for addressing these issues, particularly in China where it was elevated to national development status in the 14th Five-Year Plan as a pathway to high-quality urban development.

Industrial heritage—recording technological innovation and social transformation since the Industrial Revolution—occupies a significant position within urban renewal discourse. As industrial production shifts and economies restructure, these sites face abandonment, demolition, or redevelopment, raising important questions for urban planning and heritage conservation (J. Yao et al., 2019).

In response, industrial heritage landscape design has evolved as a paradigm for the adaptive reuse of these spaces. These landscapes represent hybrid spaces that integrate historical and industrial elements within natural and artificial environments, preserving the cultural heritage of industrialization while repurposing abandoned infrastructure (Kirkwood, 2003).

The sustainable development framework has redefined approaches to industrial heritage conservation. Following the World Heritage Convention and the recognition of cultural landscapes as World Heritage, current practices emphasize multi-stakeholder coordination, holistic protection of tangible and intangible elements, and alignment with broader urban economic, social, and environmental objectives (Tang & Yang, 2022).

While these issues are global in scope, their manifestation in Beijing—a city with abundant industrial heritage—is particularly illustrative. As the capital of China, Beijing exemplifies both the progress and the challenges of industrial heritage conservation (Wang et al., 2023). Digital technologies—including 3D scanning, virtual and augmented reality (VR/AR), and geographic information systems (GIS)—have created new possibilities for documenting, managing, and interpreting industrial heritage landscapes by capturing physical spaces, historical information, and cultural significance (Y. Yao, 2021; Zhang et al., 2021).

1.1 Digital Industrial Heritage Landscape

In recent years, digital technologies have been widely used in all stages of landscape construction, including survey and documentation, conservation design and elaboration and dissemination, and there have been many attempts in the field of industrial heritage (Trepal et al., 2021). For instance, Trepal et al.'s Keweenaw Time Traveler—a Historical Geographic Information System (HGIS)-based project—offers a historical data management and public participation platform for the Michigan Copper Mining District. In Portugal, the Pombatu project uses GIS and VR to reveal the functioning of historic textile and paper mills and their impacts on surrounding communities, highlighting the multidimensional value of industrial heritage (Table 1).

Table 1. Application of digital technology in construction of industrial heritage landscape.

Application Stage	Case	Applied Technology
Heritage Information Survey & Documentation	Keweenaw Time Traveler Map	HGIS
Heritage Spatial Protection & Design	Bethlehem Steel Elevated Trestle Linear Park	Object dynamic tracking registration, mobile devices
Heritage Value Interpretation & Dissemination	Pombatu Project, Portugal	GIS, VR

The digital transformation of industrial heritage helps overcome physical, temporal, and economic constraints, supporting industrial culture development and maximizing heritage value. Broadly, it can be divided into supply-oriented and demand-oriented categories. Supply-oriented approaches involve information collection and management systems, cloud-based conservation platforms, and immersive experiences. Among them, information collection of industrial heritage is the basis for protection and reuse. Demand-oriented applications include digital museums, virtual tours, creative digital products, and interactive online platforms—among which interactive platforms play a crucial role in encouraging multi-stakeholder engagement in heritage conservation and reuse (Sun et al., 2022).

Industrial heritage, as a unique form of industrial landscape, possesses temporal and spatial integrity and carries multifunctional values. Recent studies have emphasized not only its material significance but also its intangible and evolving value as part of the urban historical landscape (Dublin Principles – TICCIH, n.d.). How to reproduce the mixed, diversified and "layered" value characteristics of industrial heritage has become a key focus in contemporary research. As a feasible way of landscape construction, digitalization has the significance of in-depth investigation.

The concept of the digital industrial heritage landscape refers to the comprehensive use of digital technologies for protecting, displaying, and interpreting industrial heritage (Bian & Brown, 2023). This is not only limited to the digital recording of physical heritage, but also extends to the in-depth analysis of cultural, historical and social dimensions (Abad, 2019). It is a multi-level and multi-dimensional concept that integrates the preservation, presentation, and interpretation of both tangible and intangible heritage. A comprehensive technical framework enables the full expression of industrial heritage values while supporting its protection, transmission, and reuse (Bian & Brown, 2023; X. Chen et al., 2023).

In the context of sustainable development, digitizing industrial heritage landscapes holds considerable significance (Orzeł & Wolniak, 2022). Digital technologies enhance conservation efficiency and accuracy through precise recording and modeling, minimizing information loss and errors common in traditional methods (Garkushenko, 2021). They also improve public awareness and engagement through digital displays and dissemination, fostering broader social participation in heritage conservation (Balogun et al., 2020). Furthermore, by enabling virtual tours and other digital experiences, these technologies support heritage tourism and stimulate local economic development (Harfst et al., 2021). Lastly, digital monitoring tools aid environmental protection and promote ecological awareness among the public (Denuwara et al., 2019).

Although digital technologies have been increasingly applied to industrial heritage landscapes, existing research often remains fragmented—focusing on technical implementation or cultural documentation in isolation. There is a lack of integrated approaches that combine spatial analysis, heritage management, and public engagement, particularly at the city-wide scale. Moreover, limited attention has been given to how digital platforms can simultaneously support participatory planning and sustainable reuse in rapidly transforming cities like Beijing.

1.2 Research Objectives

This study aims to explore digital strategies for preserving and utilizing industrial heritage landscapes within the context of urban renewal and sustainable development. It examines how digital technologies contribute to heritage conservation by analyzing their applications in industrial heritage contexts. It enhances the interaction and accessibility between the public and heritage through digital technology, promotes the application of digital technology in industrial heritage conservation and reuse as well as landscape resource management, promotes the innovation and revitalization of industrial heritage landscapes, and enhances the accessibility, perception and sustainability of urban industrial heritage landscapes.

This study not only lays the foundation for the application of digital technology in industrial heritage conservation and reuse as well as landscape resource management, but also provides new ideas for the public to share urban cultural heritage resources equally.

Beyond these fundamental contributions, this research advances landscape architecture theory and practice through three key dimensions. The proposed "identification-analysis-construction" framework integrates physical, social, and digital spaces, expanding traditional analysis paradigms for post-industrial environments. Practically, the comprehensive database and GIS methodologies provide replicable assessment tools for global application, while the digital platform demonstrates enhanced community engagement approaches. Methodologically, integrating social media analysis with spatial data introduces innovative tools for understanding public perception and use patterns, ultimately contributing to more inclusive and sustainable landscape architecture practice.

2 METHODS

Taking "identification–analysis–construction" as the research framework (Figure 1), this study explores the mutual integration of the physical space, social space and digital space of Beijing's industrial heritage through landscape object combining, object analysis and digital construction.

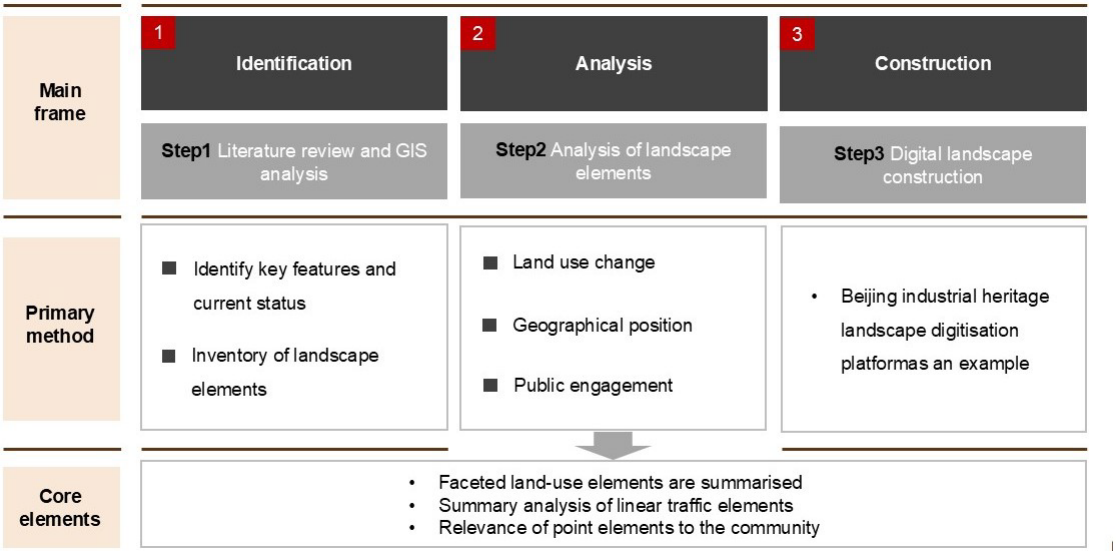

Figure 1. Identification-analysis-construction research framework. Diagram by the authors.

(1) Firstly, through literature review and GIS analysis, the main features and current status of Beijing's industrial heritage landscapes are identified, and their landscape elements are inventoried.

(2) Secondly, the elements in the landscape inventory are further analyzed in depth. Specifically, the elements of face-like land use are summarized by combining the urban renewal perspective of Beijing's urban industrial land changes; the elements of linear transportation and point-like industrial heritage landscape are analyzed by combining Beijing's location; and the elements of point-like industrial heritage landscape and points of interest (POIs) are excavated in-depth by combining the public's participation and use, and the correlation between post-industrial landscapes and communities is analyzed.

(3) Finally, on the basis of the previous identification and analysis results, the constructive framework of industrial heritage landscape digitization is explored. Taking the Beijing Industrial Heritage Landscape Digitization Platform as an example, its role in enhancing the interaction and accessibility between the public and the heritage is explored.

2.1 Study Area and Overview of Industrial Heritage Landscape

The renewal and utilization of Beijing's industrial heritage has evolved along with the transformation of the city's industrial sites. With the acceleration of urbanization and industrial transformation, industrial land is facing reconstruction, and the renewal strategy of industrial heritage has gradually shifted from direct demolition to sustainable preservation (Meng & Xiao, 2025). Beijing has actively rescued and protected a number of valuable industrial heritage, and as of February 2023, 69 sites have been listed for protection, most of which have been effectively protected and utilized in a revitalized manner (Meng et al., 2024). Beijing has continued to improve its laws, regulations and policy measures, especially the implementation of the Beijing Urban Renewal Regulations, which provides a rule of law guarantee for the protection and utilization of industrial heritage, clarifies the strategy of "retention, alteration, and demolition", and emphasizes the supplementation of urban functions and the control of styles and landscapes. These initiatives have not only guided the protection and utilization of industrial heritage, but also injected new vitality into Beijing's urban renewal and sustainable development.

Beijing's bold attempts and unremitting exploration in the practice of industrial heritage protection and utilization have produced a large number of excellent cases, presenting a rich, diversified and blossoming

situation. Based on a review of Beijing's relevant policies and urban renewal land-use regulations, this study identified and analyzed 31 industrial heritage landscapes (Table 2). These sites primarily fall into three redevelopment modes: landscape parks, cultural and creative parks, and museums. Selection was guided by multiple criteria, including historical significance (i.e., established before the 1980s), current preservation status, representativeness of various industrial sectors (such as steel, machinery, and textiles), and spatial distribution across both urban and peri-urban areas. Only sites with substantial remaining industrial structures and clearly defined spatial boundaries were included in the analysis.

Table 2. Beijing Industrial Heritage Landscape List.

Name	Type	Transformation model	Location
Shougang Industrial Heritage Park	Shougang Iron and Steel Factory	Cultural Park, Landscape Park	Shijingshan District
Urban Green Center Forest Park	Dongfang Chemical Factory	Landscape Parks	Tongzhou District
Jingzhang Railway Ruins Park	Tsinghua Park Railway Station	Community Park, Strip Park	Haidian District
798 Art District	Electronic Factory	Cultural and Creative Park	Chaoyang District
Xinhua 1949 Cultural and Financial Innovation Industrial Park	Beijing Xinhua Printing Factory	Cultural and Creative Park	Xicheng District
Zhongguancun 768 Creative Industry Park	Beijing Dahua Electronics Group	Cultural and Creative Park	Haidian District
Xihai 48 Cultural and Creative Park	Beijing Organic Glass Factory	Cultural and Creative Park	Xicheng District
Tianning 1 Cultural and Technological Innovation Park	Beijing No.2 Thermal Power Plant	Cultural and Creative Park	Xicheng District
77 Cultural and Creative Park	Beijing Offset Printing Factory	Cultural and Creative Park	Dongcheng District
Great Mill Cultural and Creative Park	Beijing No.2 Flour Factory	Cultural and Creative Park	Dongcheng District
GTC Longshuncheng Cultural and Creative Park	GTC Longshuncheng Old Factory	Cultural and Creative Park	Dongcheng District
Erqi Factory 1897 Science and Technology Innovation City	Lubao Railway Lugouqiao Factory	Cultural and Creative Park	Fengtai District
Hongxiang 1979 Cultural and Creative Park	Beijing Yingte Plastic Machinery General Factory	Cultural and Creative Park	Tongzhou District
Nine Trees Cultural Industry Park	Beijing Standard Parts Processing Factory	Cultural and Creative Park	Tongzhou District
Mikai Town Cultural and Creative Park	Beijing Second Woolen Thread Factory	Cultural and Creative Park	Tongzhou District
Donglang (Tongzhou) Film Creative Industry Park	Beijing Beifo Plastic Group	Cultural and Creative Park	Tongzhou District
Beijing Langyuan Station	Beijing Textile Warehouse	Cultural and Creative Park	Chaoyang District
Xinlu Canal Cultural and Creative Park	Fimet Metal Manufacturing Factory	Cultural and Creative Park	Tongzhou District
Love Factory Culture Industry Park	Beijing Chemical Machinery Factory	Cultural and Creative Park	Chaoyang District
491 Space	Beijing Chemical Machinery Factory	Cultural and Creative Park	Chaoyang District
Dentsu Creative Plaza	Beijing Electric Machinery General Factory	Cultural and Creative Park	Chaoyang District
Beiqi Shuangjing Cultural and Creative Park	Beijing Automobile Co.	Cultural and Creative Park	Chaoyang District
GTC Liuli Cultural and Creative Industrial Park	Beijing Glazed Products Factory	Cultural and Creative Park	Mentougou District
Laijin Creative Industry Park	Beijing No.2 Cotton Textile Factory	Cultural and Creative Park	Chaoyang District
Seven Trees Creative Park	Beijing Native Products Warehouse	Cultural and Creative Park	Chaoyang District
Xidian Memory	Beijing Glass Factory Warehouse	Industrial Park	Chaoyang District
Yuejie Jinhui Park	Beijing Nanxiaoying Heating Plant	Industrial Park	Chaoyang District
China Railway Museum	Zheng Yang Men Railway Station	Museum	Dongcheng District
Beijing Tap Water Museum	Dongzhimen Water Plant	Museums	Dongcheng District
Beijing Dragon Emblem Wine Museum	Beijing Long Hui Brewery Co.	Museums	Haidian District
Master Winemaker Art Museum	Beijing Long Hui Brewery Co.	Museums	Haidian District

2.2 Inventories of Industrial Heritage Landscapes

Object inventorying is a key analytical method in the study of historic cultural landscapes, widely applied and validated in recent years (Myers, 2016). It involves collecting, evaluating, and categorizing landscape

elements and structures within a given area to identify their defining characteristics. This process is particularly important for industrial heritage landscapes, where the systematic recording of point, line, and surface features allows for a comprehensive understanding of their condition and distribution. Such data supports the preservation of historical value and informs scientific assessment and decision-making. Moreover, inventorying enhances public engagement, promotes sustainable development, and raises public awareness of the cultural significance of these landscapes (Iqbal et al., 2022). This method provides a detailed database for protecting and utilizing industrial heritage landscapes while revealing their potential value in modern urban development.

Through a review of relevant literature, we understand the historical background, development process and current status of Beijing's industrial heritage landscape. This step helps us to establish a preliminary understanding of the research object and provides theoretical support for the subsequent GIS analysis. Next, GIS technology is utilized to spatially analyze them (Figure 2). This includes the following: 1) Surface elements: natural elements (e.g., parks, forests, and waters) and land use elements (e.g., industrial land and brownfield sites) are extracted and analyzed for their spatial distribution and role in urban renewal. 2) Line elements: such as subway and light rail lines, were assessed to understand how the transport network influences the distribution of industrial heritage sites. 3) Point elements: identify industrial heritage landscape locations and collect transportation and residential POI in Beijing to understand the relationship between these heritage landscapes and surrounding communities. Through GIS technology, a systematic inventory of the above surface, line and point elements is conducted to form a detailed database.

Through the above steps, the spatial distribution characteristics of Beijing's industrial heritage landscape and its current situation can be fully understood, laying a solid foundation for further analysis and digital construction. This stage not only helps identify the core elements of industrial heritage landscape but also reveals their interactions with other urban components, providing a scientific basis for future protection and adaptive reuse.

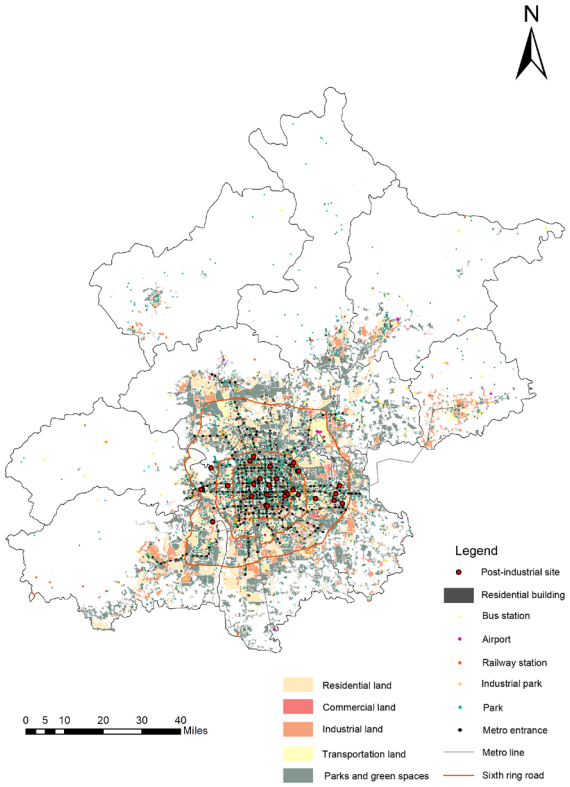

Figure 2. Beijing industrial heritage landscape inventory drawing. Reproduced from Liu et al. (2026), Landscape Architecture and Sustainability, https://doi.org/10.1016/j.las.2026.100031.

2.3 Social Media Text Mining

To better understand public perceptions and usage of 20patterns of Beijing's industrial heritage landscapes, this study integrated social media text mining with spatial analysis. Data were primarily sourced from two major Chinese location-based review platforms, Dianping and Meituan, which provide user-generated comments, ratings, and photos linked to specific sites. The analysis focused on the 31 industrial heritage landscapes identified earlier. User reviews were collected from January 2020 to December 2023 using Python-based web crawlers. Relevant entries were filtered through keyword matching (e.g., "industrial," "heritage," "culture," "park," "factory," "history") and deduplicated.

Following data cleaning, natural language processing (NLP) techniques were applied, including stop word removal, keyword frequency analysis, co-occurrence network construction and sentiment analysis. The results revealed key public concerns and emotional tendencies toward industrial heritage sites. These findings offer user-centered evidence to guide digital platform design and public engagement in the construction phase of this research.

3 RESULTS

3.1 Surface Elements of Industrial Heritage Landscape

As a large manufacturing country, China has a high proportion of industrial land. With the transformation of economic structure and industrial upgrading, industrial land needs to be upgraded. Rapid urbanization leads to traffic congestion, pollution and other problems. Beijing, as the capital city, has seen a significant increase in urbanization and low-end industries, leading to urban diseases (W. Chen et al., 2024). In the context of saturated land development, the evacuation of non-capital functions is a necessary way to improve the quality of the capital's development. Through remote sensing images, GIS technology and internet POI data, the land use and industrial land in the six districts of Beijing were finely divided. The condition realizes the fine extraction of various urban land use types and clarifies the spatial and temporal changes of urban land use development. Based on the remote sensing image data and POI data in 2013 and 2023, a study on the refined extraction of spatial and temporal changes of industries in Beijing was carried out, and the results generated by the two types of data were compared and analyzed (Figure 3).

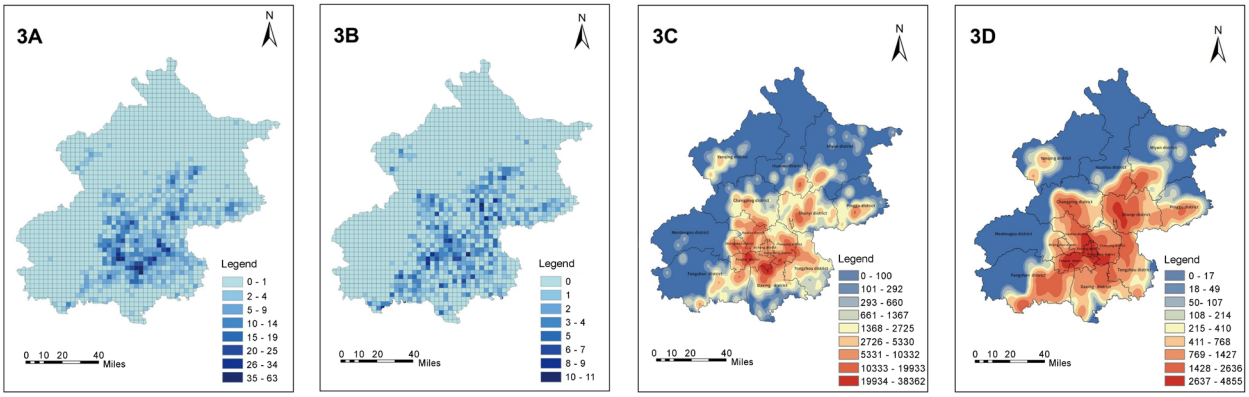

Figure 3. The spatial and temporal changes of industries in Beijing. Diagram by the authors.
(A) Number of factories in Beijing in 2013, (B) Number of factories in Beijing in 2023, (C) Kernel density of Beijing factories in 2013, (D) Kernel density of Beijing factories in 2023

Beijing has realized the transformation of industries from concentration to diffusion throughout the region through the policy of non-capital function relocation. High-density industrial districts decreased and medium-density districts increased, and from 2013 to 2019, factory clusters in the six urban areas expanded, freeing up land resources and providing opportunities for high-precision development. Low-density areas gained momentum for development, improving land utilization and people's living standards. The increase in medium-density areas ensures a balance between production and life and ecological health. These changes have eased the "big city disease", promoted healthy and stable urban development, and supported industrial upgrading and expansion.

3.2 Line Elements of Industrial Heritage Landscape

The relationship between location and transportation is fully reflected in the post-industrial landscape (Figure 4). The transformation of Beijing's post-industrial landscapes takes various forms, but the sites are selected with full consideration of transportation convenience. Most of the sites are located in the vicinity of the city's main roads, with a well-developed peripheral transportation network, multiple bus lines and subway lines intersecting here, providing convenient transportation for citizens and tourists.

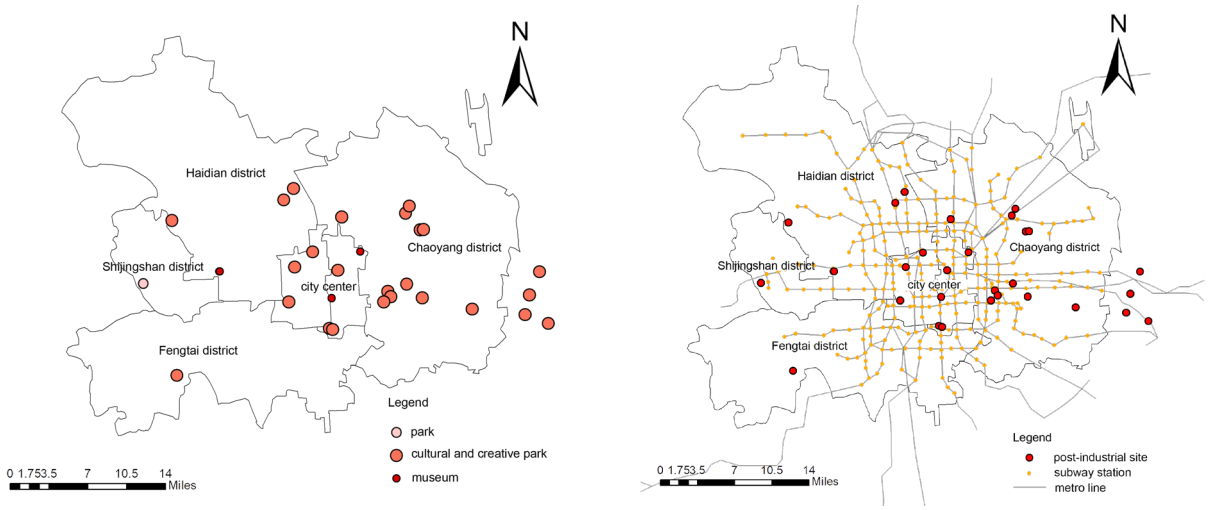

Figure 4. Industrial heritage landscape and transportation location analysis. Diagram by the authors. (A) The location of industrial heritage landscapes and transportation, (B) The transformation model of industrial heritage landscapes

The location of the landscape park also takes into account the protection and utilization of the ecological environment. It is located in the green ecological corridor of the city and is surrounded by rich natural landscape and ecological resources. In the planning and construction of the park, these ecological resources were fully utilized, and the ecological environment of the park was improved through measures such as vegetation restoration and water treatment, which enhanced the quality and attractiveness of the park. As the cultural center of the country, Beijing has a rich historical and cultural heritage and creative resources. Post-industrial cultural and creative parks often tend to be located close to areas rich in these resources, such as colleges and universities, art districts, and neighborhoods, in order to make better use of these resources and promote the development of creative industries. At the same time, these areas are also usually places with a high concentration of people, logistics and information flow, providing a favorable development environment and market opportunities for cultural and creative parks. In addition, factors of ecological environment and urban planning have also been taken into consideration. With the development of cities, people's demand for an ecological environment and livability is getting higher and higher. When selecting a site for a cultural and creative park, it usually takes into account the surrounding ecological environment and urban planning, and chooses an area with a beautiful environment and reasonable planning for construction. Such a choice is not only conducive to enhancing the quality and image of the Cultural and Creative Park, but also helps attract more talents and enterprises to move in.

3.3 Point Elements of Industrial Heritage Landscape

Beijing's industrial heritage landscape has had a significant impact on the quality of life and attractiveness of communities, driven by improvements in transportation and the addition of community POIs. First, the development of transportation POIs, such as new subway lines and road widening, not only facilitates travel for residents and tourists but also promotes the movement of people in and out of communities, enhancing community cohesion. At the same time, improved transportation has contributed to the growth of commercial and service industries, creating more employment opportunities and economic benefits for local residents. Second, the establishment of community POIs, such as the renovation of the 798 Art District and Shougang Park, has provided spaces for cultural and recreational activities, greatly enriching community life. These new POIs enhance residents' sense of identity and pride in their neighborhoods

and promote interaction among different social groups, thereby strengthening the social inclusiveness of communities (Wang et al., 2023).

In summary, the organic integration of Beijing's industrial heritage landscapes with transportation and community POIs not only improves convenience and attractiveness, but also strengthens social interaction and the cultural atmosphere within communities. This model promotes both physical and economic development, while also exerting a lasting impact on the social dimension. To achieve sustainable community development, it is essential to continue balancing the protection and utilization of industrial heritage, ensuring that residents' interests and quality of life are maintained. In this way, industrial heritage landscapes can become vital components of modern urban life and important drivers of community development.

Sustainable urban development emphasizes people-centeredness and environmental justice, with equitable access to urban open spaces as a core objective. In this context, industrial heritage landscapes serve as vital spatial carriers for promoting environmental justice and enhancing residents' quality of life and well-being. To empirically evaluate this role, we adopted a community-heritage perspective and analyzed user perceptions and experiences through social media text mining. This methodological approach enabled the collection of authentic visitor feedback and facilitated the assessment of industrial heritage landscapes' impact on community satisfaction and cultural engagement, offering insights beyond those obtained through traditional evaluation methods. These heritage-related POIs also foster residents' sense of identity and pride, while promoting social integration and inclusivity within the community (C. Yao, 2021).

Shougang Park, as a case study, represents a significant witness to Beijing's industrial development, preserving substantial iron and steel heritage while transmitting valuable industrial culture. The spatial analysis results provide insights for optimizing service planning and enhancing accessibility. As a scenic spot integrating historical industrial sites and modern cultural elements, Shougang Park attracts tourists with its unique charm. Social media text mining shows that users' comments about Shougang Park are mostly positive (Figure 5). Reviews indicate the park is rich in industrial relics, has diverse attractions, is family-friendly, and has convenient transportation. The high-tech driverless car experience brings visitors a novel feeling. However, issues include inconvenient transportation and parking, limited commercial operations, facilities needing improvement, and insufficient cultural excavation. To address these issues, we recommend increasing display boards to introduce industrial history, enriching commercial business to enhance visitor experience, improving facilities, and strengthening cultural excavation to show park characteristics. Overall, Shougang Park has achieved remarkable results in integrating history and modernity and is expected to become an important cultural landmark for Beijing, providing visitors with a richer tourism experience.

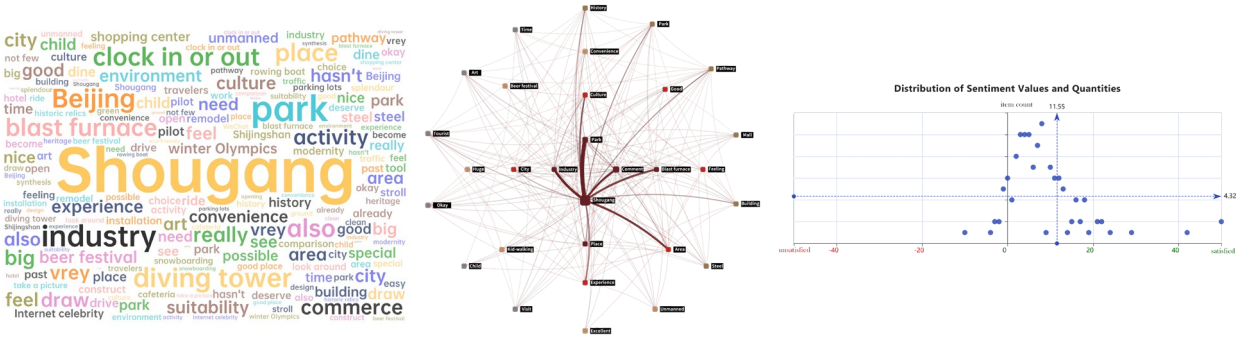

Figure5. Evaluation of public perception of Shougang Industrial Heritage Park. Diagram by the authors. (A) The word map, (B) The network relationship map, (C) The sentiment analysis scatterplot

4 DISCUSSION

4.1 Ideas and Methods for Digital Construction

The digital construction of industrial heritage landscapes involves three key steps: identification, analysis, and construction. In this process, both managerial and public needs are considered. By developing digital platforms and organizing cultural engagement activities, the protection, inheritance, and adaptive reuse of industrial heritage landscapes are promoted, ultimately contributing to urban cultural continuity and the broader goals of sustainable urban development. From the differing perspectives of managers and the public, distinct digital strategies and methods are proposed:

(1) Manager's perspective: The development of digital platforms for industrial heritage landscapes is a critical tool for their protection and utilization. Based on prior identification and analysis results, a specialized platform can be designed to support data management, resource visualization, and informed decision-making, enabling more systematic and efficient heritage landscape governance. First, an accurate and well-structured data management system is essential. This system should categorize and store inventory data, historical records, and cultural values, ensuring real-time updates and accuracy to provide reliable support for decision-making. Second, the platform should regularly publish updates, event announcements, and educational content related to industrial heritage. This enhances public awareness, broadens outreach, and encourages wider community and institutional engagement. Finally, the platform serves government agencies and policymakers by offering a foundation for strategic planning and sustainable management. The integrated data and analytical tools help provide a comprehensive overview of the current state of industrial heritage, enabling the formulation of targeted conservation policies and development strategies that advance heritage preservation in meaningful and impactful ways.

(2) Public Perspective: Digital interactive experiences play a crucial role in enhancing public engagement within industrial heritage landscape platforms. By incorporating features such as virtual tours and interactive maps, the platform can attract wider participation, foster deeper exploration, and strengthen public awareness and appreciation of industrial heritage. First, immersive virtual tours using 3D modeling or VR technologies allow users to explore heritage sites remotely, vividly presenting spatial scenes and conveying the historical and cultural value of the sites. Second, interactive mapping functions can be implemented, enabling users to click on specific site markers to access detailed information on the historical background, architectural features, and cultural significance of each location. Beyond interactive visuals, digital platforms can also host educational and promotional content—such as online exhibitions, lectures, and documentary materials—to broaden public knowledge of industrial history and culture. Feedback mechanisms and online communities can be integrated into the platform to encourage user-generated content, comments, and suggestions, thus fostering a stronger sense of ownership and belonging. Additionally, the digital platform can be linked to on-site cultural initiatives, such as industrial heritage festivals, handicraft workshops, and experiential programs, creating a hybrid digital-physical engagement model. These activities not only enhance the cultural vibrancy of heritage sites but also contribute to their long-term sustainability and community relevance.

4.2 Digital Presentation of Beijing's Industrial Heritage Landscape

The digital presentation of Beijing's industrial heritage landscape unfolds through three steps: identification, analysis and construction. Based on the preliminary identification and analysis, the construction of a digital platform for Beijing's industrial heritage landscapes plays an important role in enhancing the interaction and accessibility between the public and the heritage. Through the integration of data such as inventories of industrial heritage landscapes and further in-depth analysis of industrial heritage landscapes such as Shougang Park, the positive impacts of industrial heritage landscapes on the quality of life of the public and the attractiveness of the city at the social level are demonstrated. This digital presentation not only enables the public to have a more intuitive understanding of the characteristics and historical significance of industrial heritage landscapes, but also provides the public with more opportunities for participation and interaction, and promotes the connection and communication between the public and the heritage.

Overall, through the construction of the digital platform, the industrial heritage landscape can better interact with the public, enhance the public's awareness of and attention to the heritage, and also provide a more scientific basis and method for the protection and utilization of the heritage.

5 CONCLUSION

Through the research framework of identification–analysis–construction, this study systematically explores the digitization of Beijing's industrial heritage landscapes. First, through literature review and GIS spatial analysis, we developed a comprehensive understanding of the spatial distribution, characteristics, and current status of industrial heritage landscapes in Beijing, and established a detailed inventory of landscape elements, including surface, line, and point features. Second, drawing on urban renewal policy perspectives, we analyzed the transformation of industrial land and conducted a community-level assessment using GIS data and social media text mining. This approach enabled a multifaceted evaluation of the historical, cultural, and ecological values of the sites, as well as public perceptions and usage patterns. Finally, we constructed a digital platform for Beijing's industrial heritage landscapes based on the preceding analysis, exploring its potential to enhance interaction and accessibility between the public and industrial heritage.

Overall, this study applies a combination of literature review, GIS spatial analysis, and social media text mining to explore digital approaches for preserving and revitalizing Beijing's industrial heritage landscapes. The findings highlight the value of integrating physical, social, and digital dimensions to support evidence-based planning. For landscape practitioners and policymakers, this research offers a replicable, data-informed framework to guide the adaptive reuse of industrial heritage sites in post-industrial cities. In particular, the digital platform model provides actionable strategies for enhancing public engagement, improving site interpretation, and informing land-use planning in urban renewal contexts.

More broadly, the study contributes to landscape architecture by demonstrating how digital technologies can support participatory landscape planning and foster inclusive cultural heritage management. It underscores the importance of integrating user perceptions into design processes, while also providing scalable tools for analyzing and visualizing complex heritage landscapes. As cities worldwide face pressures of industrial decline and urban transformation, this research offers timely insights and transferable methods to promote sustainable development through digitally enhanced heritage landscape practices.

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