



Satisfaction surveys on the reuse of waterfront industrial heritage

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ABSTRACT

The transformation and reuse of industrial heritage is increasingly relevant in the context of urban renewal. However, post-transformation assessments of the built environment often receive less attention. This study examines the Jingzhou Yang Pier area in China, now a cultural and creative industrial park formerly a waterfront industrial heritage site. Through questionnaires and field survey, an innovative evaluation index system is developed for these spaces, analyzing user satisfaction via the Analytic Hierarchy Process. Findings highlight insufficient industrial historical and cultural characteristics and a lack of cultural identity post-transformation in the Yang Pier area, offering a reference for ongoing quality improvement and sustainable development of similar urban waterfront heritage projects.

KEYWORDS

post-occupancy evaluation, satisfaction survey, waterfront industrial heritage, reuse of heritage space, analytic hierarchy process

1. INTRODUCTION

In metropolitan areas, de-industrialization has caused a major land use trade-off between demolishing old buildings for new construction and restoring unused structures to preserve historical industrial value [1]. Initially, the reuse strategy followed an urban complex model to meet the needs of tourists and stimulate local consumption [2]. The focus has since shifted to comprehensive site and heritage protection, emphasizing the preservation of traditional culture and historical lineage [3].

In this context, China has prioritized the renovation and reuse planning of waterfront industrial zones, leading to initiatives like landscape parks, art centers, and cultural and creative estates developed from industrial heritage sites. Increased public interest has driven the proactive establishment of these projects; however, many have not met expectations due to unclear identities, limited civic participation, and inadequate ongoing management [4]. Consequently, these factors have contributed to reduced satisfaction and vitality in these areas.

This study investigates representative industrial heritage sites at Yang Pier along China's Yangtze River, focusing on user satisfaction with the built environment. Since 2021, the protection and renewal of the Yang Pier industrial area in Jingzhou City has been largely completed, with ongoing improvements. The study analyzes user satisfaction regarding the renovation, emphasizing their environmental behaviors and needs in public spaces post-renovation at the Yang Dock Historic District. It aims to provide insights from a user perspective to enhance the sustainability and quality of the area's reuse and development. Through quantitative analysis, first-hand feedback data is collected to identify factors affecting waterfront industrial heritage quality, addressing issues in the reuse of Yang Pier's

historic area. This provides theoretical and data support for future sustainable development and serves as a reference for similar waterfront reuse projects along the Yangtze River.

2. LITERATURE REVIEW

The spatial reuse of waterfront heritage was focused on fostering awareness of heritage conservation at beginning. During the 1960s and 1970s, some historic architectural structures and dockside facilities were included in conservation lists with the aid of government funding and policy support [5, 6]. The emphasis on economic value and benefits resulted in sporadic, short-term projects that focused on repurposing buildings on piers with high use value [7].

Within the domain of academic research, current studies on the reuse of waterfront industrial heritage encompass a variety of topics. Key areas include landscape transformation strategies for industrial sites that incorporate ecological remediation concepts [8], and the complexity of heritage conservation and reuse exemplified through actual brown-field redevelopment projects [9]. In addressing the issue of sustainable development for urban and waterfront industrial heritage projects, researchers have employed objective analytical methods to model policy support for sustainable development at historic waterfronts [10, 11]. Additionally, studies have assessed the effectiveness of adaptive reuse in the context of climate change challenges [12].

Current scholarship also delves into the reuse of waterfront industrial buildings within urban development frameworks [13], emphasizing the role of design strategies in promoting community integration and place identity through the utilization of iconic industrial structures [14]. Furthermore, the importance of local community participation in the preservation and reuse of industrial sites is highlighted [15, pp. 3–8].

Post Occupancy Evaluation (POE) research on waterfront industrial heritage space remains limited. Recently, some Chinese scholars have started utilizing post-occupancy evaluation methods to meet urban development needs. They realized to employing POE for waterfront projects based on industrial heritage can enhance future sustainable management, maintenance, and design quality [16, 17]. However, these studies only received attention in the Chinese-speaking academic community, and it is also not evaluated from the perspective of the overall space of the heritage area, which does not provide a more effective theoretical reference for the renewal and development strategy of the urban waterfront.

From a user perspective and grounded in the existing post-use evaluation theory of the built environment, this study integrates the waterfront and industrial heritage characteristics of the Yang Pier site to establish a comprehensive evaluation index for waterfront industrial heritage. This approach addresses theoretical gaps in post-use evaluations of waterfront industrial heritage. By employing the hierarchical analysis method to analyze survey results and

obtain mean satisfaction values, this study introduces an innovative quantitative approach to the qualitative study of industrial heritage. It offers scientific guidance for formulating future renewal strategies for the site.

3. RESEARCH AREA AND METHOD

The Yang Pier Historic District, situated in central Jingzhou City of Hubei Province of China, is adjacent to the Yangtze River. From the 19th century to the early 21st century, this area was a key hub for commerce, shipping, and industrial development, experiencing significant growth and subsequent decline in light industry. With the abandonment and relocation of numerous factories, the government, in collaboration with a tourism investment company, evaluated the area's industrial heritage to assess its value. Subsequently, a cultural and creative industrial park, utilizing the old industrial buildings, was opened to the public in 2022. The renovated Yang Pier Historic District features approximately 2 km of shoreline and covers a land area of about 67.5 ha.

This study examines user satisfaction in the study area through online questionnaires and field visits. The questionnaire employs a five-point Likert scale. The evaluation index system is developed by referencing existing post-occupancy evaluation frameworks while considering the unique characteristics of the Yang Pier industrial heritage site [18]. Detailed field investigations and analyses of the site environment were conducted to establish a comprehensive evaluation factor system. The satisfaction survey results are analyzed by Analytic Hierarchy Process (AHP) method. Conclusions from the post-occupancy evaluation are integrated with findings from the field research.

4. RESULT

Based on the bibliography [19] and a comprehensive field study of the transformation of the Yang Pier waterfront industrial heritage area, this study identifies five basic evaluation elements: X1 (Transportation System Space), X2 (Supporting Facilities System), X3 (Building System Space), X4 (Landscape System Space), and X5 (Public System Space). These elements serve as the foundation for analyzing the transformation objectives and outcomes of the Yang Pier Historic Area.

Additionally, through the field research on the overall situation of the transformation of the industrial heritage area of the Yang Pier and the in-depth observation and interviews on its spatial system structure and environmental details, the transformation of the Yang Pier area was horizontally decomposed, from which six representative and universal constituent elements were extracted: A) Spatial Form, B) Use Function, C) Appearance and Image, D) Artistic Aesthetics, E) Historical and Cultural Aspects, and F) Management Services [20]. By intersecting the basic

Table 1. Evaluation indicator system

Basic Evaluation Elements	Primary Evaluation Elements	Secondary Evaluation Elements
X1. Transportation System Space	A. Space form	Transportation system space spatial form Transportation system space use function Transportation system space appearance image Artistic aesthetics of transportation system space Transportation system space history and culture Transportation system space management service
X2. Facilities System	B. Usage function	Spatial form of auxiliary facilities system Use function of auxiliary facilities system Appearance image of auxiliary facilities system Artistic Aesthetics of auxiliary facilities system Historical Culture of auxiliary facilities system Ancillary facilities system management services
X3. Building System Space	C. Appearance	Spatial form of building system space Spatial Functions of Building Systems Spatial Appearance and Image of Building Systems Artistic aesthetics of building system space Spatial History and Culture of Building System Spatial Management Service of Building System
X4. Landscape System Space	D. Artistic aesthetics	Spatial form of Landscape system Use function of Landscape system space Landscape system space appearance image Art aesthetics of landscape system space History and culture of landscape system space Landscape system space management service
X5. Public System Space	E. History and Culture	Spatial form of public system space Public system space use function Public system space appearance image Artistic Aesthetics of Public System Space
	F. Management Services	Public system space history and culture Public system space management service

evaluation elements with the first-level evaluation elements, 30 second-level elements are established for evaluating the Yang Pier Historic Area. This creates a foundational set of evaluation criteria for further assessments (show in Table 1).

This study employs a combination of online and offline questionnaires to gather data. A total of 15 questionnaires were distributed to relevant professionals and industry field researchers, 150 were used for on-site surveys, and 150 were distributed online. After screening, 302 valid samples were obtained.

Expert judgment was employed to assess the importance of each indicator, yielding 15 valid expert responses. The hierarchical analysis method was utilized to determine the weights of indicators at both the second-level and basic evaluation element levels. The basic evaluation elements include X1 (Transportation System Space), X2 (Supporting Facilities System), X3 (Building System Space), X4 (Landscape System Space), and X5 (Public System Space), while the secondary indicators consist of 30 specific evaluation criteria. Using a calculation formula in conjunction with parameters from the judgment matrix [20, 21], the weights of the indicators were calculated, with results presented in Table 2.

Calculations reveal that the highest globally weighted level 1 indicator is X3 (building system space) at 28.14%, while X5 (public system space) is the lowest at 10.47%. The top secondary indicator is X3-5 (historical and cultural

aspects of the building system space) at 5.91% of the global weight (see Fig. 1).

Based on the global weights derived from the above weighting system and substituting them into the satisfaction value of the questionnaire data statistics, the overall satisfaction score was calculated to be 3.23 (shown in Table 3).

It was graded according to the division criteria in the Table 4, resulting in an overall satisfaction score of general satisfaction.

5. DISCUSSION

Data analysis resulted in an overall satisfaction score of 3.23 for the reuse of the Yang Pier industrial heritage site, indicating a general level of satisfaction [22]. Among the first-level evaluation indicators, the building system space held the highest global weight, while the public system space had

Table 2. Judgment matrix

	A1	A2		An
A1	a11	a12		a1n
A2	a21	a22		a2n
.....				
An	an1	an2		ann

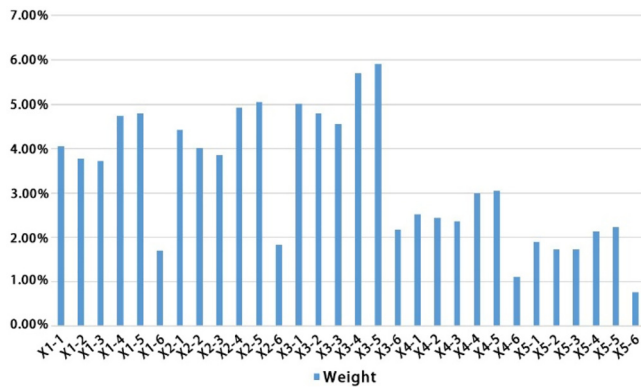


Fig. 1. Weighting of evaluation indicators based on the AHP method

the lowest. For the secondary indicators, the top five weights were: X3-5 (History and Culture of the Building System Space), X3-4 (Artistic Aesthetics of the Building System Space), X2-5 (Historical Culture of Auxiliary Facilities System), X3-1 (Spatial Form of the Building System Space), and X2-4 (Artistic Aesthetics of the Auxiliary Facilities System), ranked in descending order.

In conjunction with the field research, the problems are as follows:

- *Lack of Historical and Cultural Expression.* Despite utilizing old industrial buildings, the renovated site lacks industrial identity and site-specific features, creating an insufficient industrial atmosphere. Poor publicity and guidance for cultural venues, like industrial history museums, limit their popularity and effectiveness. Meanwhile, as the Yang Pier is

Table 3. Overall scoring

Indicator Level	Average Satisfaction Level	Global Weights (%)
X1-1. Transportation system space spatial form	3.20	4.06
X1-2. Transportation system space use function	3.15	3.78
X1-3. Transportation system space appearance image	3.28	3.72
X1-4. Artistic aesthetics of transportation system space	3.15	4.74
X1-5. Transportation system space history and culture	3.20	4.79
X1-6. Transportation system space management service	3.21	1.70
X2-1. Spatial form of Auxiliary Facilities System	3.19	4.42
X2-2. Use function of Auxiliary Facilities System	3.32	4.02
X2-3. Appearance image of Auxiliary Facilities System	3.58	3.86
X2-4. Artistic Aesthetics of Auxiliary Facilities System	3.30	4.93
X2-5. Historical Culture of Auxiliary Facilities System	3.12	5.05
X2-6. Ancillary facilities system management services	3.28	1.83
X3-1. Spatial form of building system space	3.29	5.01
X3-2. Spatial Functions of Building Systems	3.25	4.80
X3-3. Spatial Appearance and Image of Building Systems	3.27	4.56
X3-4. Artistic aesthetics of building system space	3.28	5.69
X3-5. Spatial History and Culture of Building System	3.16	5.91
X3-6. Spatial Management Service of Building System	3.43	2.18
X4-1. Spatial form of Landscape system	3.35	2.52
X4-2. Use function of Landscape system space	3.15	2.44
X4-3. Landscape system space appearance image	3.27	2.36
X4-4. Art aesthetics of landscape system space	3.26	3.00
X4-5. History and culture of landscape system space	2.91	3.05
X4-6. Landscape system space management service	3.29	1.10
X5-1. Spatial form of public system space	3.15	1.90
X5-2. Public system space use function	3.22	1.73
X5-3. Public system space appearance image	3.24	1.72
X5-4. Artistic Aesthetics of Public System Space	3.30	2.14
X5-5. Public system space history and culture	2.93	2.23
X5-6. Public system space management service	3.25	0.76
Final Score	3.23	

Table 4. Satisfaction rating criteria

Score Range	$Z \leq 1.5$	$1.5 < Z \leq 2.5$	$2.5 < Z \leq 3.5$	$3.5 < Z \leq 4.5$	$Z > 4.5$
Hierarchy	Very dissatisfied	Dissatisfied	Generally satisfied	Comparatively satisfied	Very satisfied

a creative park transformed from industrial heritage, it contains special cultural connotations. By organizing cultural activities to attract visitors to this demand can be better combined with the cultural attributes of the site, this aspect is not yet ideal;

- *Management and Development Inconsistency.* The park, intended to cluster creative industries, lacks elements of art and creativity, with few related industries introduced. Instead, a riverside market boosts popularity but creates a chaotic environment, misaligning with the site's renovation goals.

6. CONCLUSION

A post-use assessment of the transformation and reuse of Jingzhou Yang Pier's industrial heritage space in China, based on a questionnaire and user satisfaction analysis, indicates general satisfaction with the Yang Pier area. Despite successful transformation and cultural heritage presentation, issues persist:

- The site lacks a historical and cultural atmosphere, with insufficient cultural signage and guidance, underutilizing its potential as a cultural venue;
- There are limited functional business types, failing to create a rich cultural and creative environment, resulting in low visitation frequency by residents, who primarily visit for the waterfront experience.

This evaluation highlights existing issues from the perspectives of user needs and spatial perception, offering recommendations for the Ocean Terminal area's continuous quality improvement and sustainable development.

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