

Analysis of Visiting Functional Requirements of Site Museums Based on KJ Method and KANO Model - The Southern Han Mausoleums Museum As An Example

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Abstract:

In recent years, a surge in visitors to Site Museums, often referred to as “museum mania”, has been observed. Simultaneously, there has been a notable disparity in visitor numbers among various site museums. To address this issue, the study utilizes the KJ method to summarize and categorize the functional needs of site museums. Additionally, it applies the KANO model to classify these functional needs. Further analysis involved ranking the functional requirements by calculating the Better-Worse coefficient. This process aims to clarify the prioritization of the design direction for site museums. The evaluation is demonstrated using the Southern Han Mausoleums museum as an example. The study revealed that prioritizing historical ambiance, site preservation, exhibition space, publicity and promotion, and heritage display emerged as crucial design elements for increasing visitor traffic. These choices also align with the must-be quality in traditional site museum design. As well, online exhibits and architectural form are categorized as attractive qualities. These are identified as secondary design considerations to enhance visitor traffic, with functional items ranked in order of importance. The study results offer a theoretical reference system for categorizing the functional needs of site museums. They are anticipated to be practically applied in the design and renovation of museums.

Keywords:

Heritage Sites, Museums, KJ Method, KANO Model, Functional Needs of Visitors, The Southern Han Mausoleums Museum

1. Introduction

As one of the four major ancient civilizations in China, it boasts rich resources in large sites, encapsulating five thousand years of cultural heritage. It serves as a

witness to the development history of the Chinese nation and stands as a “living fossil” within modern cities. Recognizing culture as the root of a country and the soul of a nation, the national policy of building a culturally strong country has now started to pivot towards site museums. According to the statistics from the State Administration of Cultural Heritage, China has currently established over 300 site museums. Examples include the Emperor Qinshihuang’s Mausoleum Site Museum, the Jinsha Site Museum in Chengdu, and the Sanxingdui Museum. However, based on current internet data, only a dozen or so site museums are actively visible to the public, while many others have been excavated and re-buried due to modern urban developments. Therefore, there is an urgent need to enhance the attractiveness of site museums. This study utilizes KJ analysis and the KANO model to analyze tourists’ decision-making factors for visiting site museums, using the Southern Han Mausoleums museum as an illustrative example. This involves categorizing the functional needs of visitors and prioritizing their importance. The research aims to offer targeted guidance and practical references for the renovation and construction of heritage museums.

1.1. Overview of site museums

The concept of a heritage museum was defined at the 11th Copenhagen Congress organized by the National Museums Association in 1974. It was described as “a public and permanent institution, not seeking profit, dedicated to serving society and its development. Its fundamental duty is to collect, preserve, and study testimonies about human beings and their environment, presenting them to the public for education and enjoyment” [1]. In China, Wu Yongqi et al [2] proposed in “Introduction to Site Museology” that site museums should be established on ancient cultural sites. These museums are specialized in the excavation, conservation, research, and display of the culture of the site. In summary, the definition of the functions of heritage museums, both at home and abroad, is relatively consistent. These functions are commonly summarized as “protection”, “research”, and “display”. In recent years, as archaeological aspects of site museums have progressed, the research on museum design has become increasingly multidimensional. It is now essential that designs are holistic and progressive [3], meeting the evolving needs of the public. Considering the ontological complexity of site museums and the challenges in interpreting historical materials [4], it is imperative to design and manage functional requirements more purposefully. This is crucial for enhancing the attractiveness of site museums and improving the overall experience for public visits.

1.2. Analysis of Current Situation

With the liberalization of travel restrictions and advancements in public education, “museum visits” have emerged as a popular tourism trend this year. Renowned site museums, including the Emperor Qinshihuang’s Mausoleum Site Museum and the Sanxingdui Museum in Guanghan, achieved record-breaking visitor numbers in 2023, with 10 million and 1, 468, 000 visitors, respectively. However, there is a more pronounced polarization in the number of visitors to Chinese site museums. For instance, the daily patronage at the Emperor Qinshihuang’s Mausoleum Site Museum and the Sanxingdui Museum in Guanghan reaches 27, 405 and 1, 917, respectively. In contrast, the Southern Han Mausoleums Museum in Guangzhou, the capital of Guangdong Province, attracts only 96 visitors per day. This stark contrast underscores the insufficiency of the functional aspects of site museums, posing a challenge where some museums risk losing their fundamental role in promoting Chinese culture and

history. Through field research at the Southern Han Mausoleums Museum, this study identified certain issues. Employing the KJ method, it integrated functions that should be added to site museums. The KANO model was then used to re-rank the functional requirements for site museums. This process will guide the enhancement and upgrading of the Southern Han Mausoleums Museum, ensuring better alignment with the needs of the public and enhancing overall attractiveness and visitor experience.

2. Materials and Methods

2.1. Acquisition of functional requirements based on the KJ method

The KJ method, also recognized as the Affinity Diagram or Affinity Diagram method, was introduced by Jiro Kawakita, a Japanese anthropoculturalist and professor at Tokyo Institute of Technology. Kawakita published this scientific method in 1964 [5]. “KJ” represents the initials of Kawakita’s last name. The KJ method serves as a technique to categorize existing functional requirements based on the design object. Simultaneously, it aids in the development of new functions to address both explicit and implicit user needs. This approach is particularly suitable for addressing complex situations, such as those found in heritage museums with diverse user groups and multi-disciplinary system requirements, aiming to establish an organized system of requirements. In Figure 1, the flowchart illustrates the application of the KJ method for conducting a functional requirements analysis of a site museum.

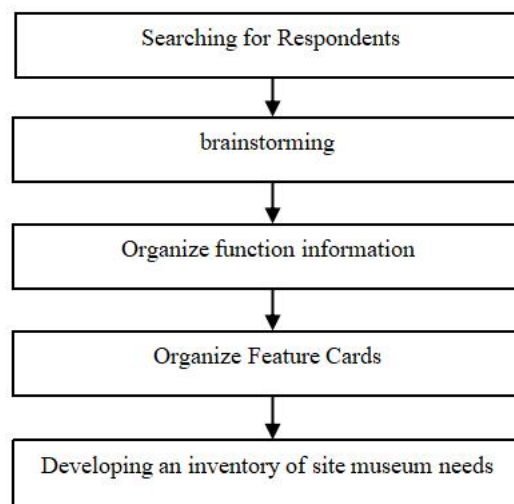


Figure 1. Process of Obtaining Functional Requirements for Site Museums Using the KJ Method.

(1) Identifying Interviewees: This phase involves reaching out to individuals who have visited the Southern Han Mausoleums Museum and those who have not. The study includes interviews with designers specializing in visual communication design, environmental design, digital media design, and other related disciplines.

(2) Brainstorming Session: Participants will contribute insights on the functional needs of a site museum, focusing on the central theme of “Functions of a Site Museum” and thinking creatively. Key questions include: What functions do you believe an ideal site museum should have?

(3) Organizing Functional Information: This stage involves consolidating the functional information gathered during the brainstorming session. The study synthesizes synonymous information, eliminates redundancies, and refines the language to create a “functional requirement card” for the heritage museum.

(4) Sorting Functional Cards: Organize and categorize the Functional Requirements Cards. Initially, categorize the functional information objectively to establish the second level of functional needs. Following the attraction system theory by Chen Yanying et al [6], the first level of functional needs is identified and named.

(5) Compilation of Functional Requirements List: At the conclusion of the entire process, a comprehensive list of functional requirements for the site museum is generated. This list encompasses both the first-level functional requirements and their corresponding second-level functional requirements.

2.1.1. Formation of site museum function cards

In this study, designers were individually interviewed to understand their motivations for visiting or not visiting site museums. The interviews were structured based on the categorization of site museum design systems. The study involved 110 respondents, comprising 20 designers with expertise in visual communication design, 33 in environmental art and design, 18 in digital media design, and 38 in various other design disciplines. During the interviews, participants engaged in brainstorming sessions and discussions regarding the functions that could attract tourists to site museums. The central theme guiding these discussions was “Functions of a Site Museum.” Through the synthesis of key insights, consolidation of main points, and the integration of synonyms using various methods, the study generated the “Functional Card of Site Museums.” Specific details are presented in Table 1.

Table 1. Functional Cards for Site Museum Features.

Serial Number	Functional Item	Serial Number	Functional Item
1	Site Preservation	9	Cultural and Creative Sale
2	Site Restoration	10	Educational Activities
3	Local Characteristics	11	Transportation & Accommodation
4	Historical Ambience	12	Architectural Form
5	Heritage Display	13	Landscaping
6	Publicity Promotion	14	Exhibition Space
7	Offline Guided Tour	15	Service Facilities
8	Online Exhibition	16	Public Art

2.1.2. Forming a list of functional requirements for a heritage museum

This study is grounded in the tourist attraction system proposed by Chen Yanying et al, comprising three main components: the attraction of tourist resources, attraction of tourist services, and attraction of tourist environment. Utilizing this theoretical framework, the study categorizes the functional items of site museums based on their objective connections to the attractiveness system of a tourist destination. Through this process, the study identifies the first-level functional indicators and their corresponding second-level functional indicators. Subsequently, it compiles a list of functional requirements for the site museum, as depicted in Table 2.

Table 2. List of Functional Requirements for Archaeological Site Museums

Serial Number	Level 1 Functional Indicators	Level 2 Functional Indicators
1	Attractiveness of tourism resources	Site Preservation
2		Site Restoration
3		Local Characteristics
4		Historical Ambience
5		Heritage Display
6	Attractiveness of tourism	Publicity Promotion

7	services	Offline Guided Tour
8		Online Exhibition
9		Cultural and Creative Sale
10		Educational Activities
11		Transportation & Accommodation
12	Attractiveness of the tourist environment	Architectural Form
13		Landscaping
14		Exhibition Space
15		Service Facilities
16		Public Art

2.2. Functional requirements analysis based on KANO modeling

Building upon the list of functional requirements for site museums organized through the KJ method, this study will delve into the comprehensive classification and prioritization of these functions using the KANO model. The KANO model, developed by Noriaki Kano, a Japanese management scientist [7], is an analytical framework designed to classify quality and rank the importance of user requirements. The subsequent text will elaborate on the process of applying the KANO model. This study aims to offer insights into the functions of site museums based on this analytical model, providing valuable guidance for their design and improvement. This model categorizes functional requirements into six quality dimensions.

(1) Attractive Quality (A): Users will be more satisfied when the feature is provided, and they won't be dissatisfied when the feature is not provided.

(2) One-dimensional Quality (O): The provision of the feature satisfies the user, and dissatisfaction occurs when the feature is not provided.

(3) Must-be Quality (M): Providing the feature does not increase satisfaction, but not providing it will result in dissatisfaction.

(4) Indifference Quality (I): Providing or not providing the feature has no impact on user satisfaction.

(5) Reverse Quality (R): Users will be dissatisfied if this feature is provided.

(6) Questionable Quality (Q): Data culling.

2.3. Design of the questionnaire

For the questionnaire design, this study formulated a KANO two-way questionnaire by presenting the 16 functional requirements as both positive and negative questions. As an example, considering the "providing site preservation" functionality, this study formulated the following questions to gauge users' satisfaction with the provision or non-provision of this service. For the positive question, "Does it provide site protection?" the options include "like it a lot", "accept reluctantly", "don't care", "inevitable, of course", and "dislike it a lot". The negative question, "Does it not provide site protection?" has options such as "like it a lot", "accept reluctantly", "don't care," "inevitable of course," and "dislike it a lot". Each of the five options corresponds to an assigned score ranging from 5 to 1. The detailed assignment criteria are presented in Table 3 and will be discussed in detail later.

Table 3. KANO Evaluation Table.

Functional		Negative question				
		Disliked it a lot (1 point)	Accept reluctantly (2 point)	Don't Care (3 point)	Inevitable of course (4 point)	Like it a lot (5 point)
Positive question	Disliked it a lot (1 point)	Q	R	R	R	R
	Accept reluctantly (2 point)	M	I	I	I	R
	Don't Care (3 point)	M	I	I	I	R
	Inevitable of course (4 point)	M	I	I	I	R
	Like it a lot (5 point)	O	A	A	A	Q

2.3.1. Questionnaire collection and organization

The questionnaire survey for this study amassed a total of 452 responses. Among the respondents, 47. 79% had visited the Southern Han Mausoleums museum, while 52. 21% had not. This distribution aids the study in obtaining a comprehensive understanding of the factors influencing visits to the Heritage Museum, including both those who visited and those who did not. The surveyed population was primarily local, constituting 79. 65%. However, the visitation rate among nearby residents and foreign tourists combined only accounted for half of the total. This suggests that the Southern Han Mausoleums museum may have a relatively low presence in tourist attractions, limiting its appeal. The majority of respondents fell within the 18-25 age group (57. 3%), with the 26-30 age group following closely at 26. 99%. This age demographic, known for being frequent users of mobile applications and significant travelers in the tourism industry, holds substantial influence over the design of system requirements for heritage museums. The collected data indicate that the surveyed population of the Southern Han Mausoleums museum encompasses diverse demographic segments. However, considering the local survey rate and visitation rate, it becomes evident that the museum has limited current appeal. Therefore, focusing on design enhancements and increasing visitor numbers by reconfiguring its functional demand system would be a strategic approach.

2.3.2. Reliability Validity test

To ensure the validity and reliability of the questionnaire information, this study conducted both reliability and validity tests. Reliability tests employed Cronbach's coefficient (Cronbach's alpha value) [8]. The results revealed an alpha value of 0. 771 for the heritage museum questionnaire, indicating excellent reliability and allowing for further analysis (refer to Table 4 for details). The validity test utilized the KMO value and Bartlett's test of sphericity [9]. The KMO value for the heritage museum questionnaire was 0. 864, significantly surpassing the 0. 8 threshold, indicating highly suitable information extraction. Additionally, the p-value of Bartlett's test of sphericity was 0. 00, signifying a passed test with a significant positive correlation (refer to Table 5 for details). The obtained results affirm that the site museum

questionnaire fulfills the criteria for acquiring accurate and reliable information, offering high-quality, dependable data for the subsequent KANO modeling analysis.

Table 4. Reliability Test Analysis.

Cronbach's Reliability Analysis - Simplified Format		
Item count	Sample size	Cronbach α ratio
37	452	0. 771

Table 5. Validity Test Analysis.

KMO and Bartlett's test		
KMO coefficient		0. 864
Bartlett Sphericity Test	approximate chi-square (math.)	9497. 859
	<i>df</i>	666
	<i>p coefficient</i>	0. 000

2.3.3. KANO model analysis

The results of the KANO model analysis were synthesized to classify the 16 demand functions, and the classification results were calculated based on the five qualities (M, O, A, I, R) in the KANO model, as presented in Table 6. Building upon these results, a comprehensive synthesis, summarization, and in-depth analysis were conducted.

Table 6. Summary of KANO Categories and Better-Worse Data for Site Museum Functional Requirements.

Summary of KANO model analysis results									
Functional	M	O	A	I	R	Q	Classification results	Better	Worse
Site Preservation	8. 63%	66. 37%	4. 20%	14. 60%	3. 98%	2. 21%	O	75. 24%	-79. 95%
Site Restoration	1. 33%	2. 65%	9. 29%	74. 56%	8. 63%	3. 54%	I	13. 60%	-4. 53%
Local Characteristics	48. 45%	14. 38%	13. 05%	19. 69%	1. 55%	2. 88%	M	28. 70%	-65. 74%
Historical Ambience	3. 54%	63. 27%	13. 05%	15. 04%	1. 77%	3. 32%	O	80. 42%	-70. 40%
Heritage Display	7. 74%	60. 18%	8. 85%	19. 25%	1. 77%	2. 21%	O	71. 89%	-70. 74%
Publicity Promotion	4. 87%	61. 73%	8. 63%	21. 02%	0. 66%	3. 10%	O	73. 10%	-69. 20%
Offline Guided Tour	47. 35%	14. 38%	13. 94%	21. 24%	0. 44%	2. 65%	M	29. 22%	-63. 70%
Online Exhibition	2. 88%	10. 18%	59. 29%	23. 45%	1. 55%	2. 65%	A	72. 52%	-13. 63%
Cultural and Creative Sale	2. 65%	6. 86%	11. 95%	74. 78%	1. 77%	1. 99%	I	19. 54%	-9. 89%
Educational Activities	3. 10%	9. 29%	13. 05%	71. 24%	1. 11%	2. 21%	I	23. 11%	-12. 81%
Transportation & Accommodation	6. 19%	15. 04%	10. 40%	66. 15%	0. 66%	1. 55%	I	26. 02%	-21. 72%
Architectural Form	3. 54%	12. 17%	57. 08%	23. 89%	1. 33%	1. 99%	A	71. 62%	-16. 25%

Summary of KANO model analysis results									
Functional	M	O	A	I	R	Q	Classification results	Better	Worse
Landscaping	15.71%	12.39%	13.94%	54.42%	1.33%	2.21%	I	27.29%	-29.13%
Exhibition Space	4.20%	62.61%	10.84%	20.58%	0.22%	1.55%	O	74.77%	-68.02%
Service Facilities	50.44%	17.26%	8.41%	21.68%	0.66%	1.55%	M	26.24%	-69.23%
Public Art	1.99%	13.72%	15.04%	66.37%	0.44%	2.43%	I	29.61%	-16.17%
M: Must-be Quality; O: One-dimensional Quality; A: Attractive Quality ; I: Indifference Quality; R: Reverse Quality, Q: Questionable Quality									

The KANO model analysis results rely on the maximum value of the numerical ratio for attribute definition, enabling the categorization of functional requirements. However, this approach lacks the ability to rank them, introducing certain limitations. To delve into the fundamental needs of users and elucidate the importance of each functional requirement, this study introduces the Better-Worse coefficient proposed by Berger et al. 's research team. The coefficient calculates the absolute values of B and W for the 16 functional items. Specifically, the Better-Worse coefficients are calculated as Better SI = $(A + O) / (A + O + M + I)$ and Worse DSI = $-1 * (O + M) / (A + O + M + I)$. The Better coefficient ranges between 0 and 1, where larger values signify higher sensitivity and priority. Conversely, the Worse coefficient ranges between -1 and 0, with smaller values indicating higher sensitivity and priority. Building on the KANO model analysis and Better-Worse coefficient analysis, this study prioritizes four attribute classifications as follows: Must-be Quality > One-dimensional Quality > Attractive Quality > Indifference Quality. The BW value serves as the basis for ranking among functional requirement items of the same quality. "Local characteristics", "Offline guided tour", and "Service facilities" are categorized as must-be quality. Although they are ranked as "Offline guided tour" > "Local characteristics" > "Service facilities" in the functional requirements ranking, no further ranking is necessary as they represent the fundamental elements of the design's functional requirements. "Site preservation", "Historical ambience", "Heritage display", "Publicity promotion", and "Exhibition space" are categorized as one-dimensional quality. The functional requirements are ordered as "Historical ambience" > "Site preservation" > "Exhibition space" > "Publicity promotion" > "Heritage display". "Online exhibition" and "Architectural form" are categorized as attractive quality. The ranking order is "Online exhibition" > "Architectural form". Attractive attributes are crucial for enhancing visitor satisfaction, and both functional requirements need to be designed as "plus points" to enhance the overall attractiveness. Under the indifference quality category, "Site restoration", "Cultural and creative sales", Educational activities", "Transportation & Accommodation", "Landscaping", and "Public art" are prioritized as follows: "Public art" > "Landscaping" > "Transportation & Accommodation" > "Educational activities" > "Cultural and creative sales" > "Site restoration". While indifference quality has a lesser impact on visitor attractiveness, the BW values reveal the order of importance among the six needs. These can be integrated into the design as additional features to enhance the overall visitor experience.

The Better-Worse coefficients are represented in a coefficient plot, where the horizontal coordinate indicates the absolute value of Worse, and the vertical coordinate indicates the value of Better. By observing the positions of functional items on the diagram, their quality in the overall analysis can be visualized. Specifically, in the diagram, the first quadrant indicates one-dimensional quality, the second quadrant indicates attractive quality, the third quadrant indicates must-be quality, and the fourth quadrant indicates indifference quality. This graphical presentation offers a clearer depiction of the relative positions and quality attributed to each functional item in the Better-Worse coefficient analysis. (Figure 2)

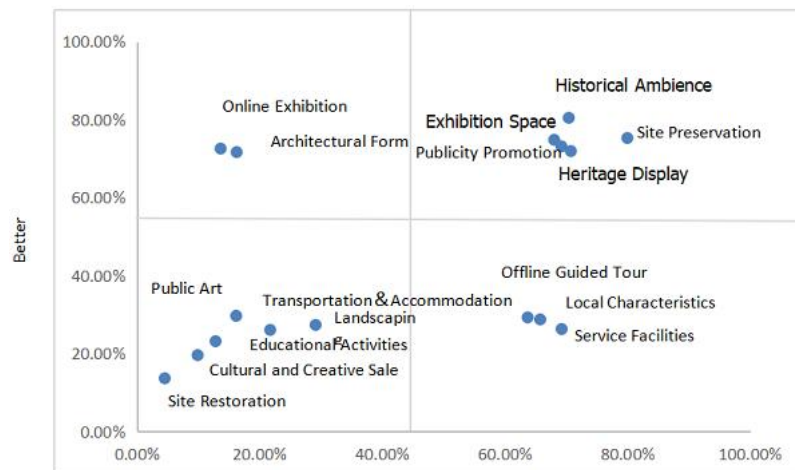


Figure 2. *Quartile Plot for Classification of Archaeological Site Museum Functional Requirement Attributes.*

3. Analysis of Results

3.1. Must-be quality of the KANO model

Analyzing the KANO model results reveals that the must-be quality comprises “Offline guided tour”, “Local characteristics”, and “Service facilities” – the fundamental functions of a site museum. They are ranked as follows: “Offline guided tour” > “Local characteristics” > “Service facilities.”

(1) Regarding “Offline guided tours”, mainstream museums employ various methods, including guided tour machines, manual explanations, and AR virtual glasses. Guided tour machines excel at information retrieval with detailed content and the advantage of repeated viewing. Manual explanations, a traditional approach, boast maturity in training systems, providing flexibility and a human touch, bridging the gap between the site’s cultural relics and visitors. AR virtual glasses represent a cutting-edge technology, delivering history and culture through dynamic animated games, reconstructing the original appearance of the site before its destruction, and enhancing visitor interest. However, technical limitations currently restrict the support of AR virtual glasses for exhibit sites. The choice of guiding methods should be tailored to different parts of the site museum, with manual explanation and AR virtual glasses deemed suitable at this stage. Considering the unique characteristics of cultural relics in heritage museums, such as the challenges of “difficult to speak” and “heavy accent” [10], manual interpretation, enriched with engaging stories, can captivate visitors, encouraging them to explore the contents of cultural relics more deeply. Simultaneously, integrating AR virtual interaction can enhance the immersive experience, digitally restoring the original appearance of the heritage site and

enriching the sensory engagement of visitors. In practical application, an organic combination of these two methods may better cater to the diverse needs of visitors.

(2) The “Local character” of a site museum is vital, providing a sense of belonging for locals and offering new cultural experiences and historical perspectives to visitors. In design, the site museum should leverage a unique design language to cultivate a local atmosphere through architectural elements and display techniques. For instance, integrating elements of the city’s history into the architectural design and incorporating local decorations ensure that the site museum retains the city’s uniqueness amidst modernization and “metabolism”.

At this stage, locals seek a sense of belonging, expressing their confidence in the city’s culture through the site museum. For travelers, the Heritage Museum provides a new opportunity for cultural experiences and historical awareness. Design should account for the diverse needs of these audiences to best showcase local characteristics. In terms of conservation and development, heritage museums should complement the urban character by incorporating the city’s historical elements into the museum design and actively participating in city cultural activities. The ultimate goal is for culture to flourish in this space, contributing a unique cultural charm to the city.

(3) The “Service facilities” of the site museum are vital elements that bridge the gap between the old and the new artifacts. Beyond the traditional scientific exhibition function, the modern site museum introduces new specialized and entertainment functions, transforming into a complex structure to enrich visitors’ tour experience. Specialized support facilities like the appraisal room, laboratory, restoration room, and cataloging room not only provide essential conditions for the museum’s appraisal, research, and preservation of cultural relics but also showcase the museum’s expertise. For instance, the appraisal room ensures the authenticity of cultural relics through professional technical support, while the laboratory and restoration room foster a conducive environment for scientific research and relic preservation.

In terms of entertainment function support, facilities such as a library, lounge, sales area, and catering offer visitors diverse choices and services. The library enables visitors to delve into the local cultural background, the lounge provides a comfortable resting space, and the sales area and catering cater to visitors’ daily needs.

This integrated architectural approach transforms the site museum into a hub for professional research and conservation of cultural artifacts while enhancing the tourists’ experience. As visitors explore cultural relics, they can relax in a comfortable environment and gain a deeper understanding of local history and culture, fostering a meaningful dialogue between the old and the new. This holistic design concept renders site museums more innovative and diverse in today’s museum construction.

In the design of the Southern Han Mausoleums Museum, we have identified certain deficiencies in some essential attributes. Concerning “offline guided tours”, the Southern Han Mausoleums Museum heavily relies on manual explanations and lacks diversified information delivery methods, potentially limiting the tourists’ experience. Regarding “local characteristics”, while the museum incorporates elements of ancient Chinese architecture in its shape and decoration, it lacks the distinctiveness of Guangzhou’s local features, making it resemble other antiquated site museums. As for “service facilities”, despite having a library function, this study notes the absence of a designated rest area. Through field research and simulated tour experiences, it was observed that tourists may experience greater fatigue during their visit.

To address these issues, this study proposes the introduction of more modern technological means for “offline guided tours”, such as tour guiding machines, AR virtual glasses, etc., to enhance the diversity of information transmission. Simultaneously, in terms of “local characteristics”, we recommend incorporating elements unique to Guangzhou to make the museum stand out. Concerning “service facilities”, apart from emphasizing the library function, this study suggests adding a designated rest area and exploring the introduction of other recreational facilities to enhance the overall visitor experience.

3.2. One-dimensional quality of the KANO model

Through the analysis of the KANO model results, this study identifies the one-dimensional quality of a site museum, encompassing “Historical ambience”, “Site preservation”, “Exhibition space”, “Publicity promotion”, and “Heritage display”. The ranking order of these qualities is “Historical ambience” > “Site preservation” > “Exhibition space” > “Publicity promotion” > “Heritage display”.

(1) “Historical ambience” stands as a pivotal element in the design of a heritage museum, playing a crucial role in attracting visitors. This concept permeates all aspects of the design, with a primary focus on crafting an immersive visitor experience through the following techniques: To begin, in the realm of cultural symbols decoration, the selection of appropriate symbols is paramount. These symbols should align with the museum’s theme and the historical and cultural background of the site. Methods such as printing, drawing, marking slogans, and hanging carvings are employed to seamlessly integrate cultural symbols into the decorative design, deepening visitors’ connection with the culture of the site museum. In the design catering to the five senses, the visual aspect involves a blend of two-dimensional graphics and three-dimensional elements, enriching the sensory experience with elements like smoke and water vapor. Regarding the auditory experience, surround sound effects, such as the hustle and bustle of ancient fairs and the cacophony of war, offer visitors a more vivid auditory journey. For the sense of touch, visitors can interact with site artifacts through virtual programs, intensifying the sense of immersion. As for the sense of smell and taste, scent diffusers can release ancient flavors, such as earth and spices, in specific environments, further elevating the historical atmosphere. The synergistic use of these techniques enables visitors to immerse themselves in a more authentic and engaging historical atmosphere in the site museum, ultimately enhancing their overall visit experience.

(2) Although “Site preservation” is rooted in the field of archaeology, the design of site museums also encompasses crucial elements of the design system. In this process, first and foremost, precision testing of the environment is essential; heritage museums must strictly control the temperature and humidity, typically maintaining the temperature between 15 °C and 20 °C, with relative humidity between 45% and 60% RH. For some special site exhibits, individualized temperature and humidity control through archaeological research is required. Second, restoration of sites and site artifacts is carried out on a regular basis. This includes consolidation and testing works to ensure the authenticity and stability of the sites—a process that necessitates detailed planning of the frequency of restoration works and specific methods to address possible challenges and difficulties. Finally, site museums require security measures to protect sites and site artifacts from external damage. High-quality exhibition cabinets for cultural artifacts serve as a critical security measure, requiring the use of sturdy materials to shield against potential human or force majeure hazards

while ensuring the clarity of exhibits. These security measures not only consider the aesthetics of the museum's design but also prioritize the overall protection of the site and artifacts, reflecting the comprehensive consideration of the design system in terms of "site protection".

(3) The "Exhibition space" plays a pivotal role in a site museum, and its spatial flow and functional layout should align with the logic of the visitor's journey to ensure a clear and organized understanding of the historical and cultural context. Design sequencing based on themes, timelines, regions, etc., enhances the visitor's experience and depth of understanding. For instance, a carefully planned spatial flow allows visitors to navigate historical development systematically, gradually exploring the rich cultural connotations presented by the site museum.

Modern technology introduces new possibilities for display, with virtual scenes reconstructing the site's original appearance emerging as a compelling technique. In contrast to traditional static displays, virtual dynamic displays significantly boost the visitor's sense of participation and active engagement by vividly "revitalizing" the site and its culture. This technological innovation not only enhances display appeal but also provides visitors with a deeper and richer learning experience. The realization of virtual scenes can be achieved through various technological means, including virtual reality, augmented reality, and others. While these technologies allow heritage museums to present historical scenes in unprecedented ways, overcoming technical challenges, especially ensuring the reliability and continuity of the technology, is crucial for the successful implementation of virtual scenarios.

(4) "Publicity promotion" is a crucial aspect of heritage museum design. In establishing a recognition system, careful consideration should be given to the design of the logo and tagline. Logos and slogans serve as iconic elements of the museum, acting as a medium to communicate core values to the outside world. This involves decisions on colors, patterns, and their alignment with the core values of the site museums. Secondly, in-depth cultural curation is pivotal for attracting visitors. Successful thematic exhibitions deepen visitors' understanding of history and culture through unique curatorial approaches. Lectures by experts in history and cultural relics prove to be an effective method for deepening visitors' understanding of history and piquing their interest through the sharing of anecdotes and research results. Finally, activities linked to traditional festivals foster friendships and cultural identity among visitors, promoting better interaction between museums and visitors.

(5) "Heritage display" is the fundamental function of the site museum, encompassing various display options, including the presentation of time and place, use and function, and theme stories. These methods offer diverse perspectives for showcasing cultural relics and serve as essential tools in guiding visitors to a deeper understanding of history and culture. Specific display methods can be elucidated through real-world examples. For instance, highlighting the historical lineage of cultural relics through the display of time and region reveals their evolution across different historical periods and regions. The presentation of use and function showcases the diversity of cultural relics, allowing visitors to grasp their practical applications and value. The display of theme stories guides the audience to a more profound understanding of the narratives behind cultural relics. In controlling display details, attention should be given to the matching principle of cultural relic size, specific technical requirements for appropriate lighting, and the practical application of minimalist display design. Such control over details significantly impacts the

visitor's experience, ensuring a comprehensive and in-depth perception of the beauty and history of cultural relics.

(6) Overall, the analysis of the KANO model identified five one-dimensional qualities that, when delivered, would enhance visitor satisfaction. The Southern Han Mausoleums Museum excels in these desired attributes, but there is still room for improvement. **Historical Atmosphere:** The museum has successfully created a compelling historical ambiance through internal decoration, light projection, and other means, notably in the imitation of the tomb site of the King of South Vietnam and the restoration of the Nansha human head display. To further enhance the multidimensional sensory experience, the museum may consider providing a more immersive historical encounter, incorporating additional auditory, tactile, and olfactory elements. **Site Preservation and Exhibition Space:** The site museum has demonstrated proficiency in environmental control and cultural relics display. The design of the display space, especially in the Nansha human head restoration display using AR virtual interaction, is commendable. It is advisable for the museum to continue strengthening site and cultural relic protection. Additionally, in terms of display space, there is potential to incorporate more sensory experiences and innovative exhibition methods. **Publicity and Promotion:** The museum has implemented children's study activities and interactive promotions, catering to diverse age groups. To further enhance interactive promotion, the museum may explore the integration of modern interactive technology, such as message walls, to boost visibility and attractiveness. **Heritage Display:** With a wealth of artifact resources and a simulated experience, the site museum should consider optimizing the internal structure of artifact displays to prevent visitors from feeling disoriented or fatigued. This optimization could involve introducing more engaging displays and providing clearer guided tours. The Southern Han Mausoleums Museum has already achieved success in delivering desired attributes. However, continuous optimization and innovation in historical ambiance, display space, and publicity and promotion will contribute to increased visitor satisfaction and make the museum even more appealing.

3.3. Attractive Quality of the KANO model

By analyzing the results of the KANO model, this study identifies the attractive qualities of site museums, specifically highlighting "online exhibitions" and "architectural form" as crucial elements in enhancing visitor satisfaction at site museums.

(1) "Online exhibition" is an exhibition method that has rapidly gained popularity with the recent advancements in Internet technology. Through site museum platforms or websites, visitors can explore and view sites and site artifacts remotely. This form of exhibition transcends the physical museum space, giving rise to the concept of the "meta-cosmic museum". The Metaverse Museum employs hybrid virtual (MR) technology to deliver a virtual immersive experience, providing visitors with the sensation of being in the actual site museum. The use of MR technology not only enables visitors to be physically present in a virtual space but also offers an interactive experience that introduces an entirely new approach to museum visits.

The use of Mixed Reality (MR) technology is pivotal in this process. Utilizing devices such as head-mounted displays, visitors can actively engage with the virtual environment, exploring artifacts while delving into their historical backgrounds. For instance, visitors can navigate exhibits using gestures or voice commands, immersing

themselves in the narratives associated with the artifacts. This immersive experience not only broadens visitors' perceptual horizons but also introduces novel possibilities to museum exhibitions. The integration of these cutting-edge technologies not only elevates the quality of online exhibitions but also serves as a potent tool for promoting history and culture. Through digitalization, heritage museums transcend the constraints of time and space, making cultural relics accessible to a broader audience. This not only offers the public a more convenient and engaging method of learning about history but also sparks increased interest and participation in historical and cultural pursuits.

(2) "Architectural form" serves as a paramount element in the capacity of a heritage museum as a historical and cultural vessel. It not only employs a distinctive architectural language to establish a historical and cultural ambiance, emphasizing protection and inheritance, but also endeavors to integrate modernity and tradition. This integration is achieved through a comprehensive consideration of the historical context, cultural elements, distinctive characteristics, and the natural environment.

Architectural form constitutes not only the outward manifestation of the building but also serves as the initial element perceived by tourists, wielding a pivotal influence on their attraction. A distinctive architectural form, particularly a design that seamlessly amalgamates modern elements with traditional culture, has the potential to create a lasting impression in the minds of tourists. Achieving this profound integration necessitates thorough research and comprehension of history and culture throughout the design process, ensuring that the architectural form exudes a contemporary feel while conveying profound cultural significance.

(3) The Southern Han Mausoleums Museum's current online exhibition exhibits certain deficiencies that require attention for increased visitor satisfaction. Areas for improvement encompass the clarification of orientation and structure, enhancement of the audio-visual experience, design of a roamable 3D virtual space, and the integration of interactive comment features. Additionally, it is advisable to organize regular online activities and introduce incentive mechanisms to foster public participation.

The architectural form of the museum, based on the design concept of "Heavenly Circle and Earthly Places," prominently features Lingnan characteristics. The building incorporates the design of an imitation wooden structure with flying eaves and corners, not only serving practical functions but also conveying the unique architectural style of Lingnan. By seamlessly integrating traditional and modern elements, including pavilions, halls, and corridors, the museum forms a multi-level architectural complex. Coupled with the courtyard layout, it creates a museum building that is rich in local characteristics.

3.4. Indifference Quality of the KANO model

Under the assumption that must-be quality, one-dimensional quality, and attractive quality have been thoroughly addressed, "public art", "landscaping", "transportation & accommodation", "educational activities", "cultural and creative sales", and "site restoration" are identified as undifferentiated attributes with a lesser impact on visitor attractiveness. Among these, "educational activities", "cultural and creative sales", and "site restoration" fall under the category of indifference quality, signifying a comparatively lower influence on visitor attraction. These elements can be briefly and

purposefully considered in additional design efforts to further enhance the overall museum experience.

As an illustration, the museum area could be enriched culturally through thoughtfully designed public artwork. For landscaping, the selection of vegetation and layout could contribute to creating a pleasant environment, potentially emphasizing characteristic local plants. In addressing transportation and accommodation, efforts may focus on providing convenient access to transportation and highlighting nearby dining and accommodation options for visitors. Educational activities might involve organizing lectures and workshops to enhance the museum's educational function. Cultural and creative sales could introduce innovative products related to the museum, enhancing visitors' shopping experience. Regarding site restoration, technical means or model displays might be utilized to offer visitors a more intuitive understanding of the original appearance of the site. These supplementary design elements can be seamlessly integrated into the overall planning to craft a more cohesive and enriched museum visit experience.

4. Discussion

Through an in-depth analysis of the KANO model, this study meticulously examines various qualities of site museums, presenting targeted design recommendations to optimize the visitor experience and museum attractiveness. In terms of the "Must-be Quality", the study explicitly identifies fundamental elements such as "Offline guided tour", "Local characteristics", and "Service facilities". Among these, "Offline guided tour" emerges as the paramount factor in visitor satisfaction. The suggestion is to employ diverse methods, including traditional manual explanations and modern AR virtual glasses, to cater to the diverse needs of visitors. Moving on to the "One-dimensional Quality", the research emphasizes the critical role of elements like "Historical ambience", "Site preservation", "Exhibition space," "Publicity promotion", and "Heritage display" in enhancing visitor attraction. Recommendations include the integration of cultural symbols, precise environmental control for preservation, and dynamic virtual displays to create an immersive historical ambience. Regarding the "Attractive Quality", the study identifies "Online exhibition" and "Architectural form" as key factors influencing visitor satisfaction. Suggestions involve utilizing Mixed Reality (MR) technology for immersive online exhibitions and seamlessly blending modern and traditional architectural elements to enhance the overall appeal of the museum. In terms of "Indifference Quality", elements such as "Public art", "Landscaping", "Transportation & accommodation", "Educational activities," "Cultural and creative sales", and "Site restoration" are acknowledged with relatively lesser impact on visitor attraction. Recommendations include incorporating public artwork, emphasizing local vegetation in landscaping, and providing convenient transportation options. In summary, this comprehensive analysis, guided by the KANO model, provides a scientific foundation for museum design, aiming to elevate functionality, attractiveness, and overall visitor experience in the pursuit of a more refined and human-centric museum industry.

5. Conclusions

In this study, the KJ method, KANO model analysis, and Better-Worse coefficient calculations were employed to systematically analyze and prioritize the functional needs of site museums. The findings indicate that, by ensuring the must-be quality (offline guided tours, local characteristics, and service facilities), visitor satisfaction

can be enhanced through targeted design focusing on one-dimensional quality (historical ambience, site preservation, exhibition space, publicity promotion, and heritage display) and attractive quality (online exhibitions and architectural form), thereby potentially increasing visitor numbers. This research framework provides a novel theoretical foundation for the design of site museums, with the Southern Han Mausoleums Museum serving as an illustrative case. In terms of practical design recommendations, it is advised to reinforce the desired and charismatic attributes, such as accentuating the historical ambience and optimizing the online exhibition. For a more in-depth comprehension of the study, exploring specific ranking results for different attributes and their actual impact on the Southern Han Mausoleums Museum would contribute to a more comprehensive understanding of the study's significance. It is essential to acknowledge certain limitations in this study, including sample constraints and geographical considerations. Future research endeavors could expand the study sample and delve into various regions and types of site museums, aiming to enhance the applicability and scope of the study.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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