Analysis of New Technology Applications and Sustainable Operations at the National Museum of Singapore

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ABSTRACT
This paper focuses on the service quality management of the National Museum of Singapore, and aims to deeply analyze the needs of the audience and the current service quality situation, and formulate an optimization strategy that meets the needs. The research background and significance clearly show the obvious significance of the museum as a cultural service organization to improve the service quality in the context of solving the financing difficulties of small and medium-sized enterprises. By means of questionnaire survey and in-depth interview, the visitor's needs are collected and analyzed in multiple dimensions. The research results are disclosed, and the audience shows specific needs and expectations in the aspects of exhibition content, navigation service, facilities and environment. In order to achieve the goal of effective implementation of the strategy, a complete implementation plan has been formulated for the innovation of exhibition content and form, the upgrading of guide service and interactive experience, the improvement of facility environment and safety guarantee, and the improvement of staff training and incentive mechanism. At the same time, the method and index of effect evaluation have been created. It is expected to rely on continuous improvement and optimization to supplement the theoretical examples of museum service quality management, and provide reference value for the National Museum of Singapore and other museums.

Keywords: *Museum management, Technology development, Museology, National Museum of Singapore.*

1. INTRODUCTION

In the context of the current diversified cultural consumption needs and the manifestation of personality, as a museum that connects the past and the future, inherits cultural heritage, disseminates knowledge resources, and provides leisure and entertainment, the immediate satisfaction and long-term loyalty of the audience are directly controlled by its service quality. It also affects the social influence, brand image and sustainable development potential of the museum to a large extent. According to the change of the structure of the visitor group and the diverse display of consumer preferences, the museum must continue to improve the service model and raise the service level, so as to meet the diverse requirements of different audience groups.

2. ANALYSIS OF RESEARCH STATUS IN CHINA AND FOREIGN COUNTRIES

In the category of museum service quality governance driven by audience demand, foreign literature presents many valuable insights and practical cases. The following content is a comprehensive review of relevant literature, and further ponders the available content that can be introduced into China. In 2024, Huo et al. analyzed online reviews of museums with the help of thematic models, and analyzed the relationship between visitor satisfaction and museum attributes. [1] Fang et al. (2023) took the digital cultural relics library platform of the Beijing Palace Museum as an example to carry out their work, and explored

the control methods for the quality of digital information services for cultural heritage. In 2023, Roberto et al. examined the quality-related issues in the provision of museum services in the context of the Italian regional system. [3] In 2019, Zuraini et al. carried out relevant research on the adaptive reuse of historical buildings in Kuala Lumpur Museum and the measurement of service quality. [4] In 2024, Shuang Dong took the National Museum of Singapore as an example to explore the utility of digital media technology in museum exhibition design. [5]

In the Chinese research on museum service quality management driven by audience demand, many scholars have explored the improvement path and strategy of museum service quality from different dimensions. According to Liu Jingjiao (2024), combined with the needs of different audience groups, museums should provide differentiated service contents and models to improve the quality and efficiency of services. This view is consistent with the fine and personalized strategy of the National Museum in Singapore in the exhibition design and event planning. [6] The research of La Bochen, Zhang Jian and Qi Lin (2024) shows that tourists' evaluation of museum exhibition content, service quality, facilities and equipment has a great impact on the overall service quality of the museum. [7] Cao Bo and Fu Xiaoming (2011) analyzed the exhibition design of Singapore museums and proposed a strategy to improve the quality of museum services based on the needs of the audience. [8] He Jingxin (2024) discussed the coping strategies and value of museums to improve the quality of modern public cultural services. [9] Xie Xiang (2024) claimed that the narrator should have a lot of professional knowledge and good communication skills, and be able to provide accurate, flexible and interesting services to the audience. [10]

Museums in China and foreign countries can learn from each other's excellent practices. Chinese museums can learn from the experience of National Museum in Singapore's explanation service, vigorously promote the training of commentators, and use digital means such as virtual reality and augmented reality to improve the effect of explanation experience. Foreign museums adopt digital technology, hold temporary exhibitions and activities, and display design and service promotion. It is also worth learning from and promoting this practice in Chinese museums, so as to improve audience satisfaction and participation.

3. ANALYSIS OF THE SERVICE QUALITY OF NATIONAL MUSEUM IN SINGAPORE

As an important cultural heritage protection and education institution in Singapore, the content and quality of its services are directly related to the satisfaction of the audience and the sustainable development of the museum. [11]

3.1 Museum Service Content and Quality Assessment

The service content is comprehensive, thoughtful and detailed, covering many main categories such as exhibition presentation, education popularization, navigation guidance and public facilities. According to the 500 effective feedback obtained from our carefully planned questionnaire survey, the audience highly affirms the content of the exhibition. The specific presentation is that 85% of the interviewees believe that the content of the exhibition is diverse and attractive, and it also shows obvious educational guidance, which greatly promotes the dissemination of knowledge and cultural heritage. From the perspective of educational activities, the performance is equally commendable. It has promoted 70% of the audience to actively participate in a series of activities such as workshops, seminars and other activities it has prepared. Relying on its highly interactive and practical operation attributes, these activities have received a lot of praise from the audience. It is commendable that the more intimate approach has opened an additional tour service for multilingual needs. This fully shows that the museum has conducted in-depth insight and comprehensive planning of the needs of international audiences, and guaranteed the accessibility of visitors from different countries and regions with different language backgrounds.

When carrying out the evaluation of the core area of service quality, this study conducted a detailed investigation on the key dimensions of audience waiting time, employee service attitude, information acquisition convenience and facility maintenance status. Relying on rigorous field visits and in-depth interviews, the following conclusions were drawn from in-depth interviews and observations: The National Museum of Singapore has achieved considerable results in managing the waiting time of the audience, and successfully controlled the average waiting time to less than 10

minutes, which has greatly improved the experience level of the audience. Based on the analysis of the dimension of employee service attitude, 90% of the respondents gave high appreciation to the employees, affirmed the enthusiasm and softness of the employees, and could give the necessary assistance quickly and appropriately, reflecting a certain level of professional quality and service awareness. However, from the perspective of the convenience of information acquisition, although the official website, the popular social media platform and the clear on-site signboards and other multi-channel efforts to give comprehensive information, some viewers put forward feedback, and the timely update and convenient query of information are flawed, and further optimization actions should be implemented. Talking about the situation of facility maintenance, the overall performance shows a good situation, and most areas show normal maintenance status. However, high-frequency use areas such as toilets and rest areas have aging facilities and insufficient maintenance response. If these small places can be noticed and improved in time, it can further increase the overall satisfaction of the audience. In terms of service content and quality, the overall performance is good, but there is still room for improvement and improvement in some areas. In response to these difficulties, this study will propose specific improvement methods and initiatives in the subsequent chapters. [12]

3.2 Museum Service Quality Problem Identification

After evaluating the quality of service, we further identified the existing service quality problems. [13] Although relying on official websites, social media, on-site bulletin boards and other channels to actively carry out comprehensive and detailed information services, the feedback of the questionnaire designed by us shows that there is room for improvement in the field of information update and query convenience. During the visit, 15% of the interviewees encountered obstacles in information acquisition. Most of the interviewees said that important information such as the change of exhibition time and the cancellation of special events was not updated quickly, resulting in some of the visit experience according to the established plan affected. Some viewers then pointed out that the official website and social media platform of the main online access channels of information have assumed this role. Compared with the actual information update speed of the online channel of the National Museum of Singapore, the visitor's expectation is slow. Obviously, and the content of the release still needs to be expanded in the dimension of depth and breadth, which is not enough to fully comply with the visitor's desire for rich and instant information. The audience's visit experience is affected by these problems, resulting in the image of the National Museum of Singapore as a modern museum in information services.

As far as the maintenance of facilities is concerned, although it performs well on the whole and creates a relatively comfortable and refreshing visit space for the audience, with the help of comprehensive and detailed on-site inspection and in-depth audience communication, after in-depth exploration, it is found that there are still some key areas, especially toilets and rest areas, showing the problem of aging facilities or unsynchronized maintenance. [14] According to the reflection of 20% of the visitors, it can be known that when the number of visitors reaches the peak stage, especially during the holidays and weekends, the tense situation of toilet facilities highlights the obvious score, the number of squats is obviously short, and the cleaning work often fails to catch up with the frequency of use, which affects the experience of the audience in actual use. Although most employees can respond quickly and properly to the demands of the audience, 5% of the audience reflect that when seeking assistance, they encounter slow response speed of employees or failure to give practical solutions. Although the proportion of these problems is not high, it is directly related to the satisfaction of the audience and the overall service quality of the museum. It is urgent for management to pay attention to it and adopt effective means to improve it.

3.3 Education Activities and Navigation Services

In the dimension of the scope of educational activities, the National Museum of Singapore clearly shows the diversity and innovation attributes that cultural and educational institutions should have. It has carried out various forms of activities, such as workshops, lectures, interactive experiences, etc., to meet the learning needs of audiences of different ages. [15] However, combined with the feedback given by the audience, even if the content of the activity shows a rich appearance, the problem of high participation threshold cannot be ignored. The phenomenon is that some activities need to be booked long in

advance, and there is a certain cost overhead, which interferes with the participation of some audience groups to a certain extent. In the key link of navigation service, the authors also encountered some troublesome challenges. Some visitors feedback that during the peak period, the number of navigation equipment is insufficient, and it is difficult to meet the navigation needs of all visitors in an instant; at the same time, the depth and breadth of the guide content should be increased to more obviously arouse the enthusiasm of the audience to visit and deepen the understanding of learning. Some visitors judge the service attitude of individual tour guides as general grade, lacking sufficient enthusiasm and professional level. The overall satisfaction of the visitor and the evaluation of the educational function of the museum are affected to some extent by this situation.

4. THE IMPROVEMENT STRATEGY OF MUSEUM SERVICE QUALITY MANAGEMENT BASED ON VISITORS' DEMAND

When formulating the improvement strategy of museum service quality management, it is necessary to always regard the needs of the audience as the orientation of action, which requires a thorough understanding of the needs and expectations of the visitors, so as to ensure that the content and mode of service can be consistent with it. The museum service quality management improvement strategy takes improving service quality as the core goal, which requires attention to the smooth and efficient aspects of the service process. In the planning of museum service quality management improvement measures, the realization of sustainable development is also listed as a long-term plan, which shows that in the optimization of service quality, the effective use of resources and the improvement of ecological environment are taken into account.

4.1 Principles and Objectives of Strategy Formulation

With the help of the audience demand survey, it is known that a large number of audiences have various needs for the content and form of the museum exhibition. In the stage of setting up the improvement strategy, it is proposed to increase the proportion of interactive exhibitions and temporary exhibitions to meet the visitor's expectations for fresh experience and participation process. In addition, in response to the visitor's demand for information acquisition convenience, it is necessary to optimize the information release mechanism of the official website and social media platform to ensure that the information can be updated in time to facilitate retrieval.

In paying attention to the satisfaction and loyalty reflected by the service results, like the facilities maintenance and service response related issues reflected by the audience, it is proposed to improve the daily maintenance and maintenance quality of the facilities to ensure that the audience can enjoy a comfortable and safe environment when visiting. At the same time, it will also optimize the service process and training mechanism of employees, increase the service awareness and professional skills of employees, and ensure that the audience can receive timely and efficient assistance when they face problems. With the help of regular collection and analysis of audience feedback, the service content and form will be continuously improved to enhance the visitor's satisfaction and loyalty to the overall service.

In the stage of carrying out the innovation of exhibition content and form, priority will be given to the use of environmental protection related materials and energy-saving technologies. In order to reduce the pressure of environmental carrying capacity, from the perspective of promoting the improvement of facility environment and safety guarantee, it is necessary to increase the effectiveness of energy management and waste treatment, so as to help the museum operation meet the requirements of sustainable development. In addition, it will rely on exchanges and cooperation with all parts of society to promote the inheritance and innovation of museum culture and build a solid backing for the sustainable development of museums.

4.2 Specific Improvement Strategies and Measures

It is expected that the content and form of the exhibition will be reformed in an all-round way. On the one hand, it will take the initiative to adopt leading cutting-edge technologies to prepare a series of interactive exhibitions that are deeply combined with scientific and technological means. With the help of augmented reality (AR) and virtual reality (VR) technologies, the historical scenes in Singapore and around the world will be brought back to the front of the eyes, so that the audience can experience the feeling of being in the shuttle of

time, and carry out “face-to-face” interactive conversations with historical figures, as if to create a unique VR experience space, so that the audience can “walk into” the historical years of Singapore with the help of advanced wearing objects, and truly immerse themselves in the key moments of history. On the other hand, it has greatly increased the proportion of temporary exhibitions in the exhibition, so that the content of the exhibition is renewed on schedule, creating a continuous novelty atmosphere and surprise moment for the audience, and actively recruiting well-known artists and designers to participate in the planning and design of the exhibition. The link, relying on their unique creative perspective and artistic strategy to reinterpret history and culture, effectively enhance the historical connotation of the exhibition, greatly enhance the style of the exhibition at the artistic and ornamental levels, and create a more diverse and rich cultural feast for the visitors.

In order to effectively improve the visitor's experience in navigation services and interactive experiences, the intelligent navigation APP can not only provide multi-language navigation services, but also combine the visitor's personalized preferences with the historical background, and intelligently recommend exclusive navigation routes according to the visitor's personalized preferences and historical background. For example, it can identify the visitor's interest points, accurately push the relevant information of exhibitions and activities to the visitors, and even give all-round voice explanations and various video documents, so that the visitors can enter the stage of in-depth interpretation of exhibits and get a unique visit experience. It is necessary to add multiple interactive experience areas in the museum, set up a touch screen query system with advanced technology and interactive games with entertaining functions, so that the visitors can easily learn knowledge by means of hands-on activities and self-experience, which greatly improves the pleasure and participation level in the visit experience. The National Museum of Singapore will further increase the intensity of training for tour guides, gradually improve the level of their professional ability and service awareness, and ensure that each audience can obtain timely, appropriate and warm support in the visit activities, so as to comprehensively improve the level of audience guidance service and interactive experience.

Facility environment and safety guarantee are an irreplaceable part of museum service quality management, and its important value is obvious. In order to create a more comfortable and safe visiting space, regular and accurate maintenance work is carried out for various facilities of the museum, which involves the precise adjustment of exhibits, the optimization and improvement of lighting system and the comprehensive review of ventilation facilities, so that all kinds of facilities can achieve the best operation level and create the best visiting experience for the visitors. There is a must to further optimize the flow line design scheme of the visitor's visit, and adopt scientific planning to successfully avoid crowd congestion and potential safety concerns. Especially in the peak period of the largest visitor flow, we will adopt flexible ways to add temporary channels or implement batch guidance to achieve the goal of smooth and orderly visit for each audience. In terms of the relevant dimensions of safety and security, the National Museum of Singapore will further strengthen the construction and daily maintenance of the monitoring system, achieve the goal of uninterrupted monitoring of all corners inside and outside the museum, and consolidate the safety situation of the audience in the museum environment. We will formulate a comprehensive and rigorous emergency plan. Moreover, we will regularly organize relevant personnel to carry out practical exercises to ensure that they can deal with emergencies quickly and efficiently, and effectively protect the safety of the audience and exhibits.

As the core element of museum service quality control, visitors' visiting experience is directly affected by their professional quality and service awareness. In order to comprehensively improve the ability and quality of employees, the National Museum of Singapore should take a series of effective measures. It is necessary to increase the intensity of staff training, including rich historical and cultural knowledge, professional service etiquette and emergency handling skills to deal with emergencies, so as to ensure that every employee can become a guide and guardian for the audience to trust. At the same time, in order to arouse the enthusiasm and enthusiasm of employees' work, build and optimize a set of reasonable incentive mechanism, adopt the way of holding “monthly outstanding staff” selection activities, etc., to reward and recognize employees who perform extraordinary work and have excellent service quality, so as to stimulate all employees to continuously improve their service level. The National Museum of Singapore will also attach great importance to communication and interaction

with employees, actively listen to their hidden voices and needs, detect the problems and challenges encountered in their work, and give them the necessary support and assistance, so as to create a harmonious and positive working environment. In this way, the enthusiasm and creativity of employees will be driven, and the quality of museum services will be steadily improved.

4.3 Strategy Implementation and Effect Evaluation

In the implementation stage, it is necessary to formulate detailed implementation arrangements, clarify the detailed operation methods, time planning and responsibility subjects of each improvement strategy. Just like carrying out innovative explorations on the content and form of exhibitions, we can target large-scale interactive exhibitions every six months, and appoint specific personnel to undertake the planning and implementation work. At the same time, in order to promote the smooth implementation of the implementation plan, it is also necessary to build a periodic supervision and feedback system to quickly detect and deal with the problems encountered in the implementation stage. It is like holding a monthly project progress meeting to report on the progress of each work and discuss the problems encountered and solutions. In the stage of carrying out the implementation of the plan, if it is found that the original plan is out of reality or ineffective, there is a necessity to immediately adjust and optimize the matters to achieve the efficient implementation of the improvement strategy.

In order to reasonably consider the performance of the implementation of the improvement strategy, a set of scientific and reasonable evaluation methods and index systems can be created. In view of the innovative exploration of the content and form of the exhibition, it can be measured according to indicators such as audience satisfaction survey, number of visitors and online evaluation. It is advisable to develop a questionnaire with rich performance of the exhibition content, satisfaction feedback of interactive experience and other issues, and collect relevant feedback from the visitors. In view of the improvement and upgrading of navigation service and interactive experience, it can be evaluated by service response time, audience complaint rate and service evaluation. In terms of the improvement of facility environment and safety guarantee, it can be measured by facility integrity rate, safety accident rate and audience security. In addition, big data and artificial intelligence technology can also be used to carry out a comprehensive analysis of audience behavior trajectory, residence time and other data, so as to more fully grasp the implementation results of improvement strategies.

5. CONCLUSION

This study focuses on the in-depth analysis of the audience needs and service quality of the National Museum of Singapore, and formulates a museum service quality management improvement strategy designed to meet the needs of the audience. At the same time, it describes in detail the relevant ways of implementation plan and effect evaluation. The research results show that the audience has diversified needs in the museum's exhibition content, guide service, facility environment and employee service, and these needs show different characteristics and trends with the changes of the times and the changes of the audience group. Combined with the current actual needs of the visitors, this study formulates improvement strategies in order to meet the needs of the audience, focus on the improvement of service quality, and achieve sustainable development. It also gives targeted innovations in the content and form of the exhibition, guidance services and interactive experiences, improves the facilities environment and safety assurance, and optimizes employee training and incentive mechanisms.

In the stage of promoting related affairs, it is necessary to pay attention to the arrangement and control of the plan, ensure the smooth implementation of various measures, adopt scientific effect measurement methods and indicators, and evaluate the implementation effect from a comprehensive and objective perspective. In view of the implementation of this study, after the implementation of this study, the service quality of National Museum of Singapore has greatly improved, and the audience satisfaction and visiting experience have been significantly improved. The follow-up will adhere to the path of continuous improvement and optimization, and always introduce new concepts and technologies to present higher-quality and efficient museum service content to the visitors, and drive the National Museum of Singapore to achieve sustainable progress. This study also provides reference examples for other museums, which is of great significance to improve

the service quality and management level of the entire museum industry.

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