

Research on Design Strategies of Museum Cultural and Creative Products Based on Online Evaluation and AHP Hierarchical Analysis

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Abstract: In order to promote the targeted development of museum cultural and creative products, and to achieve the goal of meeting the more diversified needs of users as well as the personalized services of enterprises. We identify users' relevant needs from a large number of online museum cultural and creative product evaluations, use the LDA model to cluster the online evaluations to derive the design dimensions and key points, and use the AHP hierarchical analysis method to qualitatively and quantitatively analyze the three dimensions of the clustering results. Based on the results of the study, three strategic development proposals for cultural and creative products are proposed: to strengthen the establishment of the museum cultural system and highlight the cultural baptism effect of cultural and creative products; to strengthen the usability of cultural and creative products in museums and reinforce the relevance of "people-objects-environment"; and to enhance the creativity of cultural and creative products and promote the cultural inheritance and innovation of museums.

Keywords: Museum; Cultural and Creative Products; LDA Model; Analytic Hierarchy Process (AHP); Design Strategy

1. Introduction to Museum Cultural and Creative Products

1.1 Concepts

ICOM's definition of a museum as an institution that preserves and displays collections has evolved from 1964, when it was first defined, to 2022, when it was proposed that museums should be inclusive, sustainable, and community-engaged ensembles. From the preservation and display of artifacts to the role of education for the general public to the

attributes of a non-profit institution, as well as the incorporation of public service education and the inclusion of intangible heritage, it has eventually developed into a position that provides a diverse user experience for the user. The museum cultural products also changed with the change of the definition of the museum, as can be seen from the government policy documents and literature collation, most of the use of the concept of "cultural products" before 2015, since the State Administration of Cultural Heritage put forward "to improve the level of cultural and creative product design in museums, relying on the exhibition to develop cultural and creative products". Since the State Administration of Cultural Heritage proposed to "improve the level of cultural and creative product design in museums and develop cultural and creative products based on exhibitions", the concept of "cultural and creative products" began to be used in the research related to museums in the academic world.

Comparing cultural creative products with cultural products, cultural products pay more attention to cultural and artistic values, while cultural creative products pay attention to the cultural nature of the products but emphasize more on the creativity of the products. The first attribute of the museum cultural creative products is cultural, followed by the products, and the cultural attributes of the museum are attached to the products by means of creativity. Through the innovative and interesting external image to respond to the cultural and spiritual core of the museum and collections, through the purchase of consumers to disseminate the museum culture, and at the same time to enhance the influence of the museum. To sum up, the definition of museum cultural creative products is summarized as follows: through

the development of museum collection resources, digging out the historical, humanistic and aesthetic values behind the cultural relics, and using innovative design as a means to form commodities with rich cultural connotations, in-depth educational significance, and both functional attributes and spiritual values.

1.2 Status of Development

From the beginning of the 1980s to the present, the development of museum cultural and creative industries in China has roughly experienced a development process from ambiguity to clarity in objective understanding and from passivity to initiative in subjective attitude.[1] Different from the political system and management mode of western countries such as Europe and the United States, the construction of museums in China has long been positioned as a non-profit public welfare organization, so the development of cultural and creative products of museums with a profit-making nature started late and lagged behind relatively. With the great popularity of the Forbidden City's cultural creativity, some museums blindly follow the trend, the development of ideas and production is out of touch, the viewer's sense of identity is low, the sales effect is unsatisfactory, and a lot of practical problems have arisen. Museum cultural and creative product development from the early stage only on the cultural relics to copy, imitation to the appearance of modeling creativity, the use of new materials and new technologies to interactive, fun, emotional, game-based creative product development and then to the design of digital cultural and creative products, witnessed the evolution and development of the cause of the museum's cultural and creative. In the tide of development of more than 6,000 museums nationwide, a large number of museums have started to carry out product development from the theoretical perspectives of new museology, experience economy theory, consumer psychology, creative industry theory, etc., while the cultural and creative products have slowly evolved from simple to complex, from single to multi-dimensional, and from artistic to technological directions.

At present, the head museums in China with strong R&D capability in museum cultural and creative products are Beijing Palace Museum, Taipei Palace Museum, National Museum of

China, Shaanxi History Museum, Suzhou Museum, Dunhuang Museum and so on. From the development mode, the main ways of domestic museum cultural and creative product development are, self-established cultural and creative R & D department, third-party design agency cooperation, small batch product customization for special exhibitions, etc.; from the sales data, in 2020, the national museum cultural and creative product income exceeded 1.1 billion RMB [2], and in 2023, only in the province of Sichuan, the museum cultural and creative income reached nearly 237 million RMB, compared with the rise of 2022 more than 150% [3], In terms of product promotion, there are several large-scale exhibitions and museum alliances for museum cultural and creative industries in China, such as the Museum Industry Alliance, the National Cultural and Creative Products Promotion Conference, and the China Museums and Related Products and Technology Expo, which provide a platform for major museums to display their products, exchange ideas, and conduct design research. Although the heat of Chinese museums' cultural and creative products is high, the vast majority of local museums still present the realistic dilemmas of fewer IPs, less traffic, less funding, less attention, etc. There is still some space for the overall development, and the development of cultural and creative products, as one of the most direct ways to open the door of the museums, still has a large space for research.

1.3 Review of the Study

As a huge treasure house of Chinese culture, museums possess rich cultural resources, and the development of museum cultural industry is also an important means to break through the bottleneck of museums. In China, the transformation of economic structure and social and cultural changes have provided external impetus for the development of museum cultural and creative industries. This is not only the increase of social demand caused by the booming creative economy, but also the urgent need for museums to sustain their own development. There is a large volume of research on the development of cultural and creative products in museums, and the research

perspectives include the prediction of the future trend of the cultural and creative industry from the perspective of the development of the cultural industry; the analysis of the modeling of the cultural and creative products from the perspective of semiotics and aesthetics; and the research on the practice of cultural and creative product development, and the extraction of data for the online cultural and creative reviews, and then empirical research is less, while the quantitative research on the products is more objectively understand the problems of the products as well as determine the development level.

2. User Demand Analysis of Museum Creative Product

2.1 Data Collection of Online Reviews of Museum Cultural and Creative Products

With the booming development of the museum creative industry, the sales of creative products are also increasing. Especially in the museum cultural and creative products online platform sales have increased by multiples, and a large amount of consumer online review data has been accumulated behind the consumption. This study selects a total of ten products with top sales in the Tmall flagship stores of national-level museums such as Beijing Palace Museum, National Museum of China, Shaanxi Historical Museum, Henan Museum, etc., and takes their online reviews as the research object to discover the differences in consumers' concerns about excellent cultural and creative products and refine the elements of consumer demand.

For the selected top-selling museum cultural and creative products, python is used to capture the online comments in the sales platform, and the time period of the collected comments is from October 2022 to October 2023, and a total of 12,635 initial data are obtained. Among them, invalid data such as default comments, multiple repetitive comments and irrelevant comments are extracted and deleted, leaving 8456 valid online comments after processing. Then the data totaling 7836 articles were obtained through the operations of data cleaning, word splitting, and de-deactivation word processing.

2.2 Analysis of Online Review Data Based on LDA Modeling

In LDA topic modeling analysis, the topic consistency (Coherence) score is used to

determine the optimal number of topics. Theme consistency refers to whether the high probability words corresponding to each theme generated by the model are semantically consistent or not, and the higher its score, the better the model results [4]. By analyzing the collected data for theme consistency, the results are shown in Figure 1, when the number of themes is 3, the consistency score is the highest, which means that the theme content is the highest discrete, and the themes are more semantically coherent and meaningful. And then as the number of themes increases, the theme consistency score no longer increases significantly. Accordingly, the number of themes implied by the text of online review data was determined to be 3.

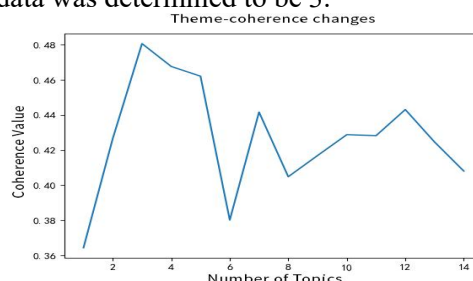


Figure 1. Results of Thematic Consistency Analysis of Online Review Data

After clarifying the number of themes through theme consistency analysis, the LDA model is used to conduct specific theme mining on the above online review data, which can provide certain directions and ideas for the development of cultural and creative products in museums. The concept of LDA (Latent Dirichlet Allocation) model was firstly put forward by BLEI and other scholars in 2003 [5], which utilizes the co-occurrence relationship between words and words to determine the theme composition of a document. The model uses word and word co-occurrence to judge the topic composition of the document, introduces word and topic Dirichlet distribution, and reasonably avoids the over fitting problem of the traditional topic model [6]. It is a three-layer Bayesian probabilistic model containing words, topics and documents. The LDA model is suitable for down scaling text vocabulary, mining the implicit relationships in it, realizing vocabulary clustering, and ultimately being able to extract the topic vocabulary therein in a large amount of textual data, identifying

the user needs hidden in the online review data. The above data are clustered by pyLDA-vis to form the visual online comment topic clustering as in Figure 2.

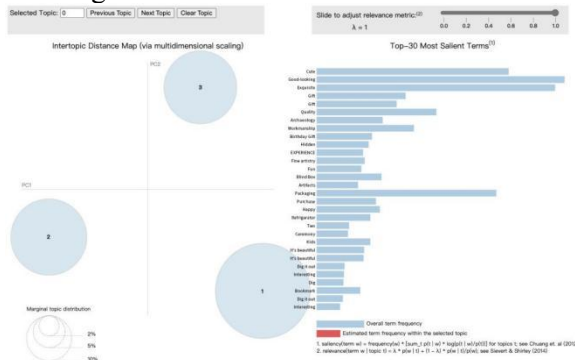


Figure 2. Theme Word Clustering Visualization Results

Table 1. Structural Mapping of Product Features to User Requirements

Theme	Theme element (Partial)	Topic clustering Name
Theme 1	Texture, refinement, beauty, beauty, packaging, color...	Appearance layer
Theme 2	Archaeological, excavation, fun, blind box, fun, ritual, toys...	Experience layer
Theme 3	Emotion, culture, memory, sensibility, spirit, happiness, resonance...	Emotional layer

During the preliminary data collection process, the number of theme and product feature words in the online comment corpus is large, and most of them are dominated by superficial feature words, and uplifting this part of words to deeper user needs is a very important process in the design of museum cultural and creative products. In order to have a clearer understanding of user needs, based on the clustering results of online review topics, the main features of museum cultural and creative products are mapped out, and the representative product needs are summarized according to their attributes. In summary, there is a mapping relationship between product feature words and user needs as shown in Table 1.

2.3 Analysis of Cultural and Creative Product Elements Based on AHP Hierarchy Analysis

Analytic Hierarchy Process (AHP) by American Operations Research Scientist, University of Pittsburgh T. L. Saaty was introduced in the early 1970s[7]. The complex decision-making problem can be decomposed into hierarchical structure, and the solution of the problem can be presented more clearly, which is convenient for decision-making behavior. The method can compare and sort among multiple elements, quickly and effectively compare the degree of

correlation between the elements, and determine the degree of correlation between the levels [8]. By comparing the judgment matrix and the mathematical method of matrix operation, the importance ranking of some elements and related elements of this level and the upper level is determined, and the composite weight of each level to the system target is calculated. After sorting, the importance of each element is presented, and finally the appropriate decision is selected [9].

2.3.1 Level indicator determination

According to the above data processing and analysis and the normalized classification of the mapped user requirements, the hierarchical structure of museum cultural and creative products is finally determined as 1 target layer, 3 primary index layers and 9 secondary index layers (Table 2). The goal level is the overall goal of the hierarchical model, that is, the design requirements of the museum's cultural and creative products. The first-level index consists of three index elements: appearance design layer, experience design layer and emotion design layer. The secondary index layer is divided in detail according to the primary index elements. Through the discussion and analysis of the theme element text by the focus group, the total nine design index elements of C1~C9 are selected, which are creative modeling, rich color, novel material, use function, fun interaction, story extension, cultural baptism, emotional resonance and spiritual support.

Table 2. Level Index of Cultural and Creative Product Design in Museum

Target layer A	First-level indicator B	Secondary indicator C
Design requirements of museum cultural and creative products A	Appearance Design layer B1	Creative modeling C1
		Rich color C2
		Novel material C3
	Experience design layer B2	Use function C4
		Fun Interaction C5
		Story Extension C6
	Emotional design layer B3	Cultural baptism C7
		Emotional resonance C8
		Spiritual trust C9

2.3.2 Indicator weight determination

Fourteen research experts in the field of museums and designers of cultural and creative products of front-line museums were selected to form decision-makers in this link, and the evaluation indexes were compared in pairs with the comparison scale of 1~9. The specific judgment matrix is

formula (1).

$$A = \begin{pmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{pmatrix} \quad (1)$$

2.3.3 Comprehensive weight determination

According to the above judgment matrix, the

weight value of each index is the eigenvector corresponding to the maximum eigenvalue of the judgment matrix, and the weight value of the judgment matrix is calculated by using the root method to obtain the comprehensive weight of the hierarchical index of museum cultural and creative products, as shown in Table 3.

Table 3. Comprehensive Weight of Cultural and Creative Product Design Level Index in Museum

Target layer A	First-level indicator B	Weight value	Secondary indicator C	Weight value	Comprehensive weight value
Design requirements of museum cultural and creative products A	Appearance Design layer B1	0.2164	Creative modeling C1	0.5760	0.1246
			Rich color C2	0.2022	0.0438
			Novel material C3	0.2218	0.0480
	Experience design layer B2	0.4108	Use function C4	0.7049	0.2896
			Fun Interaction C5	0.1048	0.0431
			Story Extension C6	0.1903	0.0782
			Cultural baptism C7	0.7058	0.2631
	Emotional design layer B3	0.3728	Emotional resonance C8	0.1080	0.0403
			Spiritual trust C9	0.1862	0.0694

According to the subject dimension and clustering results, combined with focus group discussion and expert interview, the weight value is obtained. Among them, the comprehensive weight of cultural baptism in the emotional design layer is 0.2631, the comprehensive weight of use function in the experience design layer is 0.2896, and the comprehensive weight of creative modeling in the appearance design layer is 0.1246. It can be seen that the cultural, usability and creativity of museum cultural products are the components of consumers' important purchasing intention.

3. Museum Cultural and Creative Product Design Strategies

According to the characteristics of user demand data distilled from the above quantitative research, combined with the current situation of the museum creative development market and the characteristics of the existing cultural resources, we focus on the three attributes around the cultural baptism, the use of functionality, and creative styling to formulate the development strategy of the museum's creative products, with a view to providing new ideas for the development of the museum's cultural and creative products. The specific strategies are as follows:

3.1 Strengthen the Establishment of Museum Culture System, Highlight the Cultural Baptism Effect of Cultural and Creative Products

In the construction of the museum cultural system, it is fundamental to systematically

collect, classify and analyze data on the nature of cultural relics, which includes materials, dimensions, forms, technologies and other aspects. Through the in-depth analysis of these data, the cultural laws behind the cultural relics can be revealed, and a set of metadata standards and system can be constructed to provide norms for the collection, organization, storage and management of digital data of cultural relics. This system not only promotes the standardization and systematization of cultural relics information, but also enhances data sharing and exchange between different museums and even internationally, and improves the interoperability of cultural relics data [10]. At the same time, the multi-dimensional and multi-level labeling of cultural data contributes to the effective extraction and application of digitized resources, providing rich materials for museums' digital display and educational activities, enabling museums to better manage and utilize their cultural assets, and provide the public with more in-depth and broader cultural services. The rich collection of cultural relics in museums is not only a treasure trove for the development of cultural and creative products, but also an important carrier of cultural heritage. Therefore, museums should dig deep into the stories and cultural connotations behind the cultural relics and build a complete cultural design system. This involves not only an in-depth study of cultural relics, but also an accurate grasp of market demand, so as to

develop museum cultural and creative products that have both cultural depth and meet market demand.

With the strengthening of the cultural system of museums, the cultural baptismal effect of cultural and creative products needs to be upgraded as well. The development of cultural and creative products of museums should not be limited only to the shape and color of cultural relics, but should dig deeper into the cultural connotation to satisfy consumers' demand for unique cultural experience. Through cooperation with designers and artists, museums can create novel and unique cultural and creative products, which can not only attract the attention of consumers, but also spread the museum's cultural concept. In the process of interaction between consumers and products, the richer the cultural information conveyed by the products, the more they can attract consumers and enhance the sensory experience, thus deepening the impression of the products. In short, the construction of museum cultural system is the cornerstone to enhance the cultural baptism effect of cultural and creative products. By digging deeper into the cultural connotation of cultural relics and innovating product design, museums can better fulfill their functions of cultural education and dissemination, and provide the public with richer cultural experiences. Such efforts can not only enhance the social influence of museums, but also strengthen the power of cultural dissemination, so that museums can become a cultural bridge connecting the past and the future.

3.2 Enhance the Usability of the Museum's Cultural and Creative Products, and Strengthen the Relevance of "People-Objects-Environment"

The development of cultural and creative products of museums should pay attention to the sensory and behavioral interaction with consumers. This means that product design should start from the sensory attributes of consumers, consider the interaction between products and consumers, and be able to produce sensory or behavioral level interactions. Designers should create products that are both aesthetically pleasing and practical by studying consumers' usage habits and preferences in order to enhance their experience. For example, developing educational toys or games with interactivity allows consumers to learn cultural

knowledge and enhance their memory in the process of use. In addition, museum cultural and creative products should not be limited to decorative, but should incorporate more usage functions to deepen consumers' memory and emotional connection to the products. In terms of material attributes, the products should ensure their delicacy from the perspectives of production material selection and production process, and avoid shoddy workmanship. This not only enhances the use value of the product, but also increases its collection value.

At the same time, in order to strengthen the bond between consumers and the environment in which they are used, museum cultural and creative products should take into account the environment and scenarios in which they are used, so that the products can be naturally integrated into the consumers' living environment. This requires designers to thoroughly study and understand the needs and preferences of the target consumer groups, as well as their interaction with the products and the environment. Through user research and market analysis, the direction of product design can be more accurately grasped to ensure that the product can cause consumer resonance. At the same time, museums should also make use of modern technical means, such as big data analysis and user feedback system, to continuously optimize the design and function of products. In addition, museums should strengthen cooperation with designers, cultural scholars and market experts to jointly develop cultural and creative products with deep cultural connotations as well as usability and market competitiveness. Such cross-disciplinary cooperation can bring new perspectives and innovative ideas to the museum's cultural and creative products, so that they can play a greater value in the interaction of "people-objects-environment". For example, cooperating with fashion brands to incorporate museum elements into clothing design, or cooperating with technology companies to develop intelligent and interactive cultural and creative products. These strategic suggestions will help the museum's cultural and creative products play a greater role in the interaction between "people, objects and environment", and

become a bridge connecting users and culture.

3.3 Increase the Cross-border Integration of Museums and Enhance the Creativity of Museum Cultural and Creative Products

As a gathering place of traditional cultural resources, museums carry a deeper responsibility for cultural revitalization. Nowadays, cross-border innovation and fusion development of cultural industry has become a new trend, and the cultural and creative products of museums are no exception. The development of multi-industry innovation and integration not only provides multiple paths for the development of museum cultural creation, but also opens a new door for the cultural promotion of museums. Government departments should also introduce relevant policies to promote the development of cross-border integration of museum creative industries. In addition, if the development of museum cultural and creative products is only broken up and reorganized in the framework of modeling and color, it is often impossible to jump out of the design wall. Under the background of the new era, the innovation of user groups and the growth of cultural needs also prompted the rapid iteration of museum cultural and creative products. In order to adapt to the development of society and blur the boundaries of user groups, museums need to develop new forms of cultural creations. Cross-border integration, as a means of mutual benefit for multiple industries, is still an effective path for the sustainable development of museums.

From the perspective of technology-enabled museum cultural and creative product development, the integration of culture and technology has brought new breakthroughs in museum cultural content services. In recent years, Baidu, Alibaba, Taobao as the core of the Internet enterprises, evolved a number of new museum platform economic mode, for the development of China's museum culture industry to bring great new opportunities. 5G, cloud computing and other new technologies, the rapid development of many cultural and artistic activities turned to the network platform, the digitization of cultural and creative products has ushered in a new round of prosperity. The launch of digital creative products such as "The Emperor's Day", "Mystery Palace" and "Cloud Tour Dunhuang" breaks the one-way communication mode of passive visit of

traditional museums, brings visitors closer to the psychological distance of museums and attracts more young groups to understand and identify with museum culture. Therefore, the development of the museum's cultural and creative products should not be confined to the physical products themselves, but should be developed in cooperation with other industries. For example, it should cooperate with other industries to develop co-branded products with commercial brands and theme restaurants with the catering industry. Multi-channel and diversified synergistic development of museum creativity not only broadens the road for museum creativity industry, but also brings vitality to other industries, and ultimately promotes the benign development of museum culture industry.

4. Concluding Remarks

Internet online evaluation is characterized by its invisibility, interactivity, authenticity, etc. Through the acquisition and processing of user data, the final data results derived are more effective and have a certain degree of guidance for the development of museum cultural and creative products. Through the analysis and aggregation of online comments and AHP hierarchical analysis, it is excavated that consumers pay more attention to the culture, usage and creativity of museum cultural and creative products. And the targeted relevant design strategies are proposed in order to be able to provide certain reference significance for the development of museum cultural and creative products.

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