Research on the Design of Cultural and Creative Products of Xingcheng Ancient City Based on Hierarchical Analysis Method

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Abstract. The purpose is to find an objective design method for the cultural and creative products of Xingcheng Ancient City, and to explore the cultural and creative products of Xingcheng Ancient City that satisfy users' preferences. The method is to divide the design elements of Xingcheng Ancient City into three factors, namely, cultural factors, architectural factors and functional factors, and use the hierarchical analysis method to construct a decision model to calculate the user's preference for these elements so as to determine the design objectives, and finally arrive at the design scheme for the cultural and creative products of Xingcheng Ancient City. The result is that according to the results of the consumer research, the hierarchical analysis method is used to rank the design elements, and it is concluded that the design elements led by the iconic building under the architectural element account for the highest percentage, which provides design objectives for the design practice of Xingcheng Ancient City's cultural and creative products. It is concluded that through the design elements of Xingcheng Ancient City, the Xingcheng Ancient City cultural and creative products that meet the user's needs are derived, which serve the purpose of publicizing the culture of Xingcheng Ancient City, and also provide a certain amount of exploration for the Great Wall's cultural and creative product design research.

Keywords: Analytic Hierarchy Process; Design Elements; Cultural and Creative Products.

1   Introduction

As a representative of China, the Great Wall unites the spirit of perseverance of the Chinese nation and has become an indispensable part of Chinese culture. Liaoning Province is a large province of Great Wall resources, and the Liaoning National Cultural Park Construction Group proposes that when promoting the Great Wall culture, it is necessary to combine the characteristics of the Great Wall of the Liaoning section to develop souvenirs of Great Wall cultural characteristics with culture as the core.[1] Xingcheng Ancient City, as an acropolis of the Great Wall, was in ancient times a major

transportation route from Liaodong to the Central Plains, and due to its geographic location led to it being the most important link in the Great Wall's defense system of the Ming Dynasty, the Ningyuan Acropolis.[2-3]

2   Overview of Research Methods

2.1   Analytic Hierarchy Process

Professor Thomas L. Saaty of the University of Pittsburgh, USA, proposed a decision analysis tool called the Analytic Hierarchy Process (AHP) in the early 1970s [4]. The method is a process of modeling and quantifying the decision-making thought process of a decision maker on a complex system. In this paper, the best solution is selected by building a judgment matrix and calculating the weights of the factors in the judgment matrix. [5].

2.2   The Application of Analytic Hierarchy Process in the Research of Cultural and Creative Products

Cultural and creative products are to inherit the cultural kernel with the help of product development and innovation. In recent years, research on them has focused more on digital analysis[6]. Such as the use of activation theory in design strategy[7-8]. Hierarchical analysis has both qualitative and quantitative research, and is a common method for screening the importance of perceptual intention [8]. In recent years, there have been many scholars in China who have applied the hierarchical analysis method to the design of cultural and creative products, such as applying the fuzzy hierarchical analysis method to the cultural and creative product design of gold foil [9].Hu Haoqi et al. applied the hierarchical analysis method to the cultural and creative product design of the railroad to guide the practice[10].

3   Establishment of a Comprehensive Evaluation Model Based on Analytic Hierarchy Process

3.1   Establishment of a Comprehensive Evaluation Index System

Based on the hierarchical structure of Xingcheng Ancient City Cultural and Creative Products, the key elements of Xingcheng Ancient City Cultural and Creative Products are divided into the target layer (A) as "selecting the information of Xingcheng Ancient City Cultural and Creative Products"; the guideline layer (B) as "Historical Elements (B1)", "Architectural elements (B2)", "Functional elements (B3)"; Program layer (C) for "Origin of Xingcheng (C1)", "Historical figures (C2)", "Historical Battles (C3)", "Geographical Location (C4)", "Plane Distribution (C5)", "Landmarks (C6)", "Military Defense (C7)", "Acropolis (C8)".

3.2   Method for Calculating Index Weights Based on Analytic Hierarchy Process

Fifteen students who are interested in Xingcheng Ancient City, 10 tourists and locals of Xingcheng Ancient City, and 5 research experts of Xingcheng Ancient City are invited to score the different information phrases, totaling 30 people. The scale of 1-9 is used to reduce the error caused by subjective factors, and the scales obtained from comparing the factors with each other are the inverse of each other. 1-9 scale is shown in Table 1, and the statistical scoring results are combined and organized to obtain the judgment matrix of the criterion level by the geometric mean method, which is shown in Table 2, and the judgment matrix of the factor level is the same, and we will not elaborate too much on it.

Table 1. Scale Tables for Levels 1-9.

Scale	Meaning
1	Element i and element j have the same importance
3	Element i is slightly more important than element j
5	Element i is significantly more important than element j
7	Factor i is more important than factor j
9	Factor i is extremely important than factor j
2,4,6,8	Intermediate value of two adjacent judgments

Table 2. Criteria layer judgment matrix

	B1	B2	B3
B1	1	1/7	1/3
B2	7	1	3
B3	1/3	1/3	1

It is very important to apply hierarchical analysis to maintain the consistency of judgmental thinking, in order to ensure the reasonableness of the weights of the indicators, the constructed judgment matrix is tested for consistency. In this paper, we introduce λmax to indicate the maximum eigenvalue of the judgment matrix, A is the judgment matrix, W is the weight vector, $[AW]_i$ to indicate the ith component of the matrix $[AW]$. λ max is calculated by Eq $\lambda_{max} = \sum_{i=1}^{n} \frac{[AW]_i}{nW_i}$. The consistency index CI is calculated according to Eq. $CI = \frac{\lambda_{max}-n}{(n-1)}$, $CR = \frac{CI}{RI} = \frac{\lambda_{max}-n}{(n-1)RI}$. where the average random consistency index RI of judgment matrix is shown in Table 3.

Table 3. Average random consistency index RI values for judgment matrices.

ordinal number	1	2	3	4	5	6	7	8
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41

After calculation if CR<0.1 then the matrix meets the requirements, otherwise the decision matrix needs to be corrected again until the test is passed.

Calculate the weight of the criterion layer and obtain the result based on the formula. The consistency calculation results meet the requirements (CR<0.1). This article obtains the weight values of the criterion layer judgment matrix. The calculated weights and consistency calculation results are shown in Tables 4 and 5 below.

Table 4. Judgment Matrix Weights

	B1	B2	B3
Weight	0.0879	0.6694	0.2426

Table 5. B1-B3 Consistency Check Calculation Results

λ_{max}	CI	RI	CR
3.0070	0.0035	0.58	0.0067

The factor layer C1-C8 indicators for weight calculation, according to the formula (1) ~ (3) calculation results are shown in the following table 6, 7, it can be seen that the consistency test passed (CR < 0.1). Due to the functional factors factor judgment matrix for the second-order matrix, so there is no need to carry out a one-time test of this paper to derive the weight of the factors, factors comprehensive judgment matrix weights are shown in Table 8.

Table 6. Calculated results of factorial consistency test for historical factors

λ_{max}	CI	RI	CR
3.0385	0.0192	0.058	0.0370

Table 7. Calculated results of factor consistency test for building factors

λ_{max}	CI	RI	CR
3.0290	0.0145	0.058	0.0280

Table 8. Historical factor factor judgment matrix weight values

Criteria layer	Weights	Factor layer	Weights	Composite weights
Historical Factors Factor	0.0879	Origin of Xingcheng	0.2583	0.0227
		Historical Figures	0.6370	0.0560
		Historical Battles	0.1047	0.0092
Architectural Factors	0.6694	Geography	0.0704	0.0471
		Plane	0.1782	0.1192
		Landmarks	0.7514	0.5030
Functionality Factor	0.2426	Military defense	0.75	0.1820
		Acropolis	0.25	0.0607

3.3   Xingcheng Ancient City's Cultural and Creative Product Design Practice

Based on the evaluation results of the design elements of Xingcheng Ancient City derived from the hierarchical analysis method, the first-ranked landmark building was selected as the main design body. In addition, the military defense system, which scored relatively high, was also added to the design. The design of the cultural and creative products is proposed to be centered on the above elements. In terms of design expression, the existing architectural form is redesigned. The process of graphic processing and color matching, and the design of element symbols are shown in Table 9.

Regarding the products to be developed, a preliminary study of the design elements was conducted along with interviews, and the interviewees wanted to have products that were integrated with those sold in the old town. In addition to this, there should be everyday products such as books and stationery. Combined with the cultural qualities of the old city of Xingcheng, it was decided that the iconic buildings of Xingcheng City Wall, Xingcheng Literature Temple and Ancestor's Stone Square should be made into a food bag, and that the wall of Xingcheng City should be designed as a barrier located in the lower part of the whole bag, which embodies the military defense function. And then selected the three most representative of the ancient city's architectural symbols made of medals and refrigerator stickers, so as to form a cultural product, the design program as shown in Figure 1.

Table 9. Architectural design process for the signage of the old city of Xingcheng (drawn by the researcher)

	Iconic Architecture	Element Extraction	Graphic Processing
Bell and Drum Tower			
Ancestral Stone Square			
Shing Wong Temple			

Fig. 1. Cultural and creative products of Xingcheng Ancient City (drawn by the researcher)

4   Conclusions

As the state attaches importance to the construction of Great Wall resources, the cultural resources of the Great Wall will be excavated deeper and deeper. As an industry centered on culture and creativity, cultural and creative industry can promote the development of the Great Wall National Cultural Park to a certain extent. The problem that designers cannot avoid when designing cultural and creative products is that they are too subjective, and it is easy for them to design products that are detached from the market and the users, and such products are undoubtedly failed designs. This paper uses hierarchical analysis to objectively analyze the information importance index from the user's point of view. It decides the user's preference for the design elements and verifies the practicability of the method, which provides an exploration for the subsequent research on the design of cultural and creative products of the Great Wall.

Acknowledgement

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