AHP-CRITIC-TOPSIS-based Analysis of the Influence of Young People's Preferences on the Design of Funan Wicker Home Products

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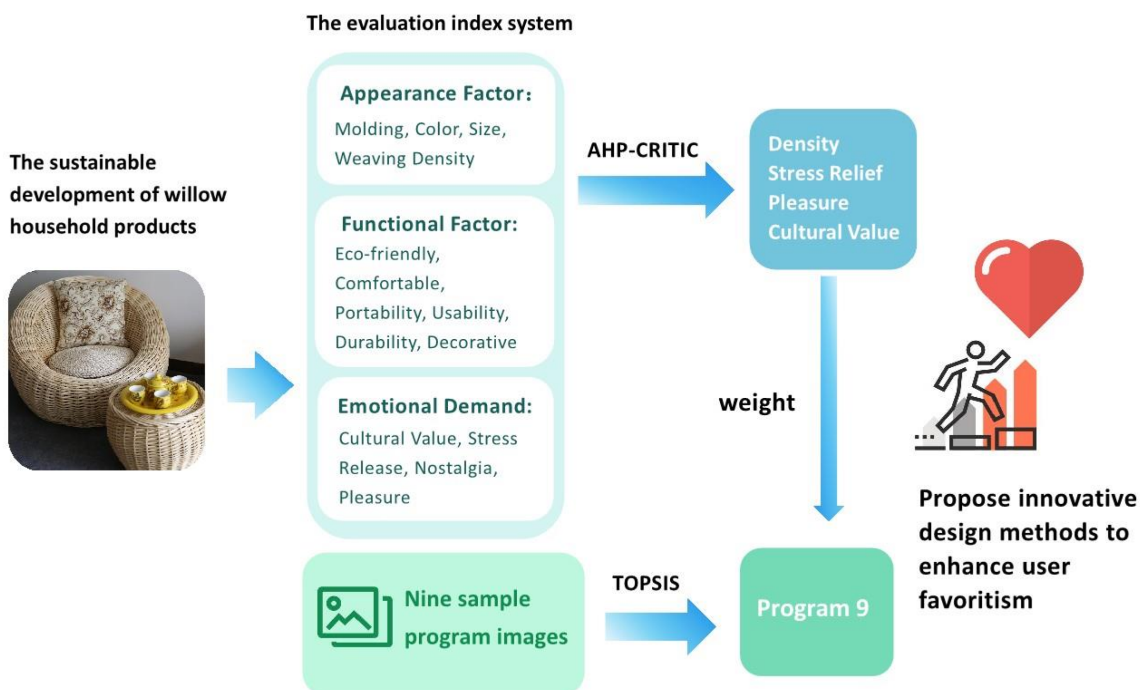
GRAPHICAL ABSTRACT



AHP-CRITIC-TOPSIS-based Analysis of the Influence of Young People's Preferences on the Design of Funan Wicker Home Products

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Wicker home products, handcrafted from sustainable materials such as willow, vine, and bamboo, embody principles of sustainable development. However, they face a lack of clear appeal among young consumers in the Chinese market. This study utilizes the AHP-CRITIC-TOPSIS method to examine user preferences for Funan Wicker home products to enhance the original products based on young users' choices in the contemporary era. Using the AHP method, 14 evaluation indicators were selected across three key factors and determined subjective weights. Objective weights were calculated using the CRITIC method to establish a comprehensive ranking. Subsequently, the TOPSIS method was employed to evaluate and order the nine design alternatives. The findings highlight a strong emphasis on emotional criteria in the evaluation process, with variables such as Weaving Fineness, Stress Release, Pleasure, and Cultural Value significantly influencing user preference. According to the calculations, the program IX with the highest proximity emerged as the optimal choice. Based on these results, the study refines design focus and quantitative indexes for willow home product designers, proposing innovative design methods that offer theoretical support and practical guidance for the development of willow products in Funan, China.

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Keywords: Willow weaving; Home products; AHP- CRITIC-TOPSIS; User preference; Innovative design

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INTRODUCTION

Willow weaving is a traditional craft that predominantly utilizes willow as its primary material, employing specialized techniques to fashion various handicrafts and daily essentials (Romero 2005). It is closely related to the lives of working people and aims to improve people's lives (Inkuer 2019). Various raw materials including different varieties of willow (such as willow, weeping willow, river willow) and fiber resources like vine, bamboo, reed, and straw can be utilized for willow weaving. Natural materials have the traits of being flexible and malleable (Dlamini *et al.* 2022), allowing for many forms and purposes to create diverse creative aesthetics and experience impacts (Yu *et al.* 2021). Funan willow weaving has a lengthy history of evolution, a substantial cultural inheritance, uniqueness, and a self-contained style (Wang *et al.* 2023a). The tradition has been ongoing for over 500 years and originated in Huanggang Town, located in the eastern side of Funan County, Anhui Province (Zhang and Zhang 2020). Funan willow weaving has undergone two significant changes after centuries of development and advancement: first, it is now possible to use a variety of weaving materials instead of just one, such as willow grass, willow iron, willow wood, and willow wood grass iron composite mixed weaving. Secondly, the range of contemporary willow weaving products extends beyond traditional agricultural equipment to include crafts in other domains, including furniture, horticulture, decorations, home goods, and ornaments (Wang *et al.* 2023b). The scale of the industry has shifted from small family workshops to large-scale enterprises (Zhu 2021), and weaving technology has advanced from a single weaving process to a composite weaving process. At the same time, Funan willow weaving continues to expand overseas markets and export to Southeast Asia, Europe, and other places. Willow weaving has so far grown into the first industry in Funan County, known as the willow culture industry (Niu and Xu 2023). Moreover, Funan wicker was included in the "National Intangible Cultural Heritage Protection List" in 2011 (Sun *et al.* 2023), possessing a distinct aesthetic expression and utilitarian significance.

Willow weaving is a traditional handicraft with natural, green qualities. It aligns with the idea of sustainable design, which is environmentally favorable at every stage of its life cycle—from production to use to disposal (Zheng and Zhu 2021). Wicker, a natural material known for its eco-friendly properties, is utilized in modern home product design to enhance innovation and diversity in this field (Xiong *et al.* 2020), as well as to address the market's need for environmentally friendly materials (Xiong *et al.* 2017). Simultaneously, willow weaving furniture is created with traditional handicrafts, preserving national culture and traits and enjoying widespread domestic and international praise. Europe and North America have been particularly welcoming to it. The product is now a daily essential in numerous families, with a growing demand (Wang *et al.* 2023b). In terms of material, craftsmanship, construction, function, and ornamental, the modern home has matured with time (Zhang *et al.* 2022a). However, as a result of fast urbanization and socioeconomic change, people are living faster, under more mental stress, and dealing with an increasing number of mental health issues (Oh and Boo 2021). Cultural values and emotional expressions incorporated in house design are especially significant because people's requirements can no longer be satisfied by the practicality and comfort characteristics of existing home products (Ibrahim 2014; Pizzato and Macedo 2019; Liu *et al.* 2021). This makes Funan willow weaving home goods unique; the organic materials, including the willow's curved shape and natural hues, evoke a sense of proximity to the natural world. People might feel at ease and serene in this natural setting, which releases tension and stress. The weaving incorporates the thoughts and aesthetic concepts of the willow weavers, reflecting their pursuit of beauty with rich cultural connotations and emotional expression. At the same time, the unique weaving technique tests the skill of the willow weavers and their mastery of the weaving process (Wang *et al.* 2023a). This handicraft's human touch has the power to affect people's feelings, pique their interest in art, and provide them with comfort and pleasure.

Various constraints impede the growth of Funan's willow weaving home enterprises. Enterprises do not fully grasp the cultural relevance of willow weaving art and the need of conserving traditional crafts (Shen *et al.* 2022). Furthermore, enhanced promotional efforts are required. Issues including talent attrition and inadequate development of craft skills continue because the cultural significance of willow weaving objects has not been thoroughly investigated (Sun *et al.* 2023). The willow home furnishings industry is oversaturated because of the changing consumer consumption trends and a lack of innovation and cultural backing for traditional items, resulting in unfulfilled modern customer demands. Moreover, the lack of unique brand attributes and the prevalence of product standardization worsen the problem (Zhu 2021).

The Industrial Design Competition "Funan, The Capital of Wickerwork in China" Willow Weaving Household Special Competition supports the inventive growth and creative transformation of Funan's willow weaving culture with the People's Government of Funan City. To give Funan willow woven home products a new lease on life, more young designers must get involved in the process, delve deeply into the demands of users in the modern era (Li *et al.* 2023a; Yu *et al.* 2023a), optimize and upgrade the original products, and design new products that are tailored to modern living. Nonetheless, a great deal of products' consumer preferences and acceptability remains unknown (Raycheva and Angelova 2017) and relevant design evaluation research is now at an exploratory stage (Tian *et al.* 2017). Design assessment plays a pivotal role in enhancing the relevance and coherence of design solutions. This paper examines the Funan willow weaving home products crafted by a representative cohort of college students, delving into their design creativity and youth group demand to inform future development strategies for willow weaving products. Additionally, the paper provides recommendations for Funan willow weaving enterprises to tap into the youth market and navigate the transformative landscape of the new era.

EXPERIMENTAL

Methods

Liu *et al.* (2023a) utilized the Analytic Hierarchy Process (AHP) to determine the weight ranking of 14 factors in the object hierarchy for dining room chair design. This ranking offers design focus and quantitative indexes for designers in the initial stages of the design process. Then, at the late stage of the dining chair design process, the fuzzy hierarchical analysis (FAHP) method was employed to evaluate the three design options statistically and determine the best design solution. Sun *et al.* (2023) focused on the sustainable development of Huaihe willow wickerwork, assessed consumer willingness to purchase through questionnaires. Four innovation hypotheses were developed based on the diffusion of innovations theory. Subsequently, a hierarchical analysis of hierarchy model consisting of four criteria layers and 20 factor layers was constructed on this basis. Finally, the judgment matrix was then utilized to establish the relative weight values of the criteria and factor layers. Li *et al.* (2023b), based on the various human-computer interaction (HCI) methods in education, applied the CRITIC technique to assign weights to selected parameters, and employed the TOPSIS strategy to rank alternatives based on performance values to select the best alternative from a pool of 10 options. Zhang *et al.* (2022b) proposed a multi-criteria decision making method based on interval type 2 fuzzy sets. Subjective weights were obtained by AHP method and objective weights were obtained by CRITIC method. Alternatives are sorted using an enhanced TOPSIS method based on interval type 2 fuzzy sets. This strategy minimizes the numerical discrepancies in assessment outcomes, improving the reliability of the decision-making process when compared to conventional methods.

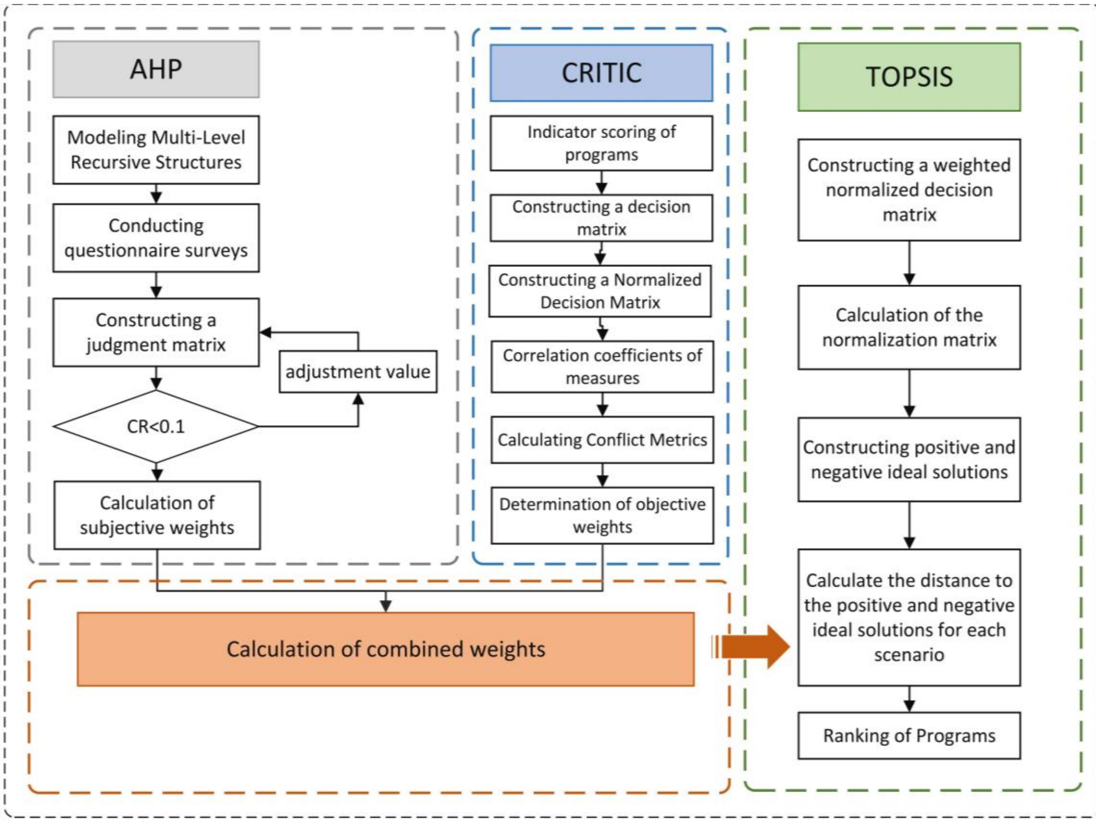

Fig. 1. Basic flowchart of the method

The findings of the studies mentioned above served as a basis for this paper's research by offering specific methodological expertise and references. The arrangement of relevant literature leads to the conclusion that various research techniques are available for assessing willow home product design. The AHP approach and the CRITIC method are quite typical weight calculation techniques, and they both hold a significant place in the comprehensive evaluation (Zhao and Xu 2023). The CRITIC method eliminates the errors caused by subjective evaluation, making decision-making more objective and accurate (Krishnan *et al*. 2021). Meanwhile, the hierarchical analysis method (AHP) can play the importance of subjective evaluation by experts in decision making (Hsu *et al*. 2008; Liu *et al*. 2023b). It uses consistency analysis to test subjective judgments and reduce bias (Saaty 1985; Zhou *et al*. 2022). The sequential selection methodology is also studied using the TOPSIS method for similarity with ideal solutions (Lai *et al*. 1994). The sorting process determines the hierarchy of solutions, aiding in R and amp; D planning and product positioning. To enhance the data's accuracy, this study merges subjective assignment weights from AHP with objective assignment weights from CTITIC. Subsequently, the derived comprehensive weights are integrated with the rigorous evaluation approach of TOPSIS, establishing a preference model for designing willow weaving home products based on AHP-CRITIC-TOPSIS. Finally, a logical and scientifically grounded preference method is established, illustrated through an exemplary design program, and a more rational design strategy is proposed in light of the analysis results. To enhance the feasibility of design concepts, this study advocates for evaluating and optimizing wicker home products using the AHP-CRITIC-TOPSIS technique. Figure 1 outlines the fundamental flow of the method.

Sample Selection

The KJ method was utilized to categorize and arrange user-endorsed creative designs of wickerwork home items and to pinpoint typical examples of wickerwork home products. The specific steps that were undertaken are as follows (Cheng and Leu 2011):

The first step was to extensively collect samples. The winning entries from the Anhui Industrial Design Competition's unique competition, "China Willow Weaving Capital - Funan," in 2020, 2021, and 2022 were gathered and arranged. All of the material images are the creations of college students and design majors from all over China, and the majority of them have already been produced as actual objects. To guarantee the rationality and impartiality of the study sample, designers collected and examined 34 photos of willow home items to establish a collection of materials, as shown in Fig. 2.

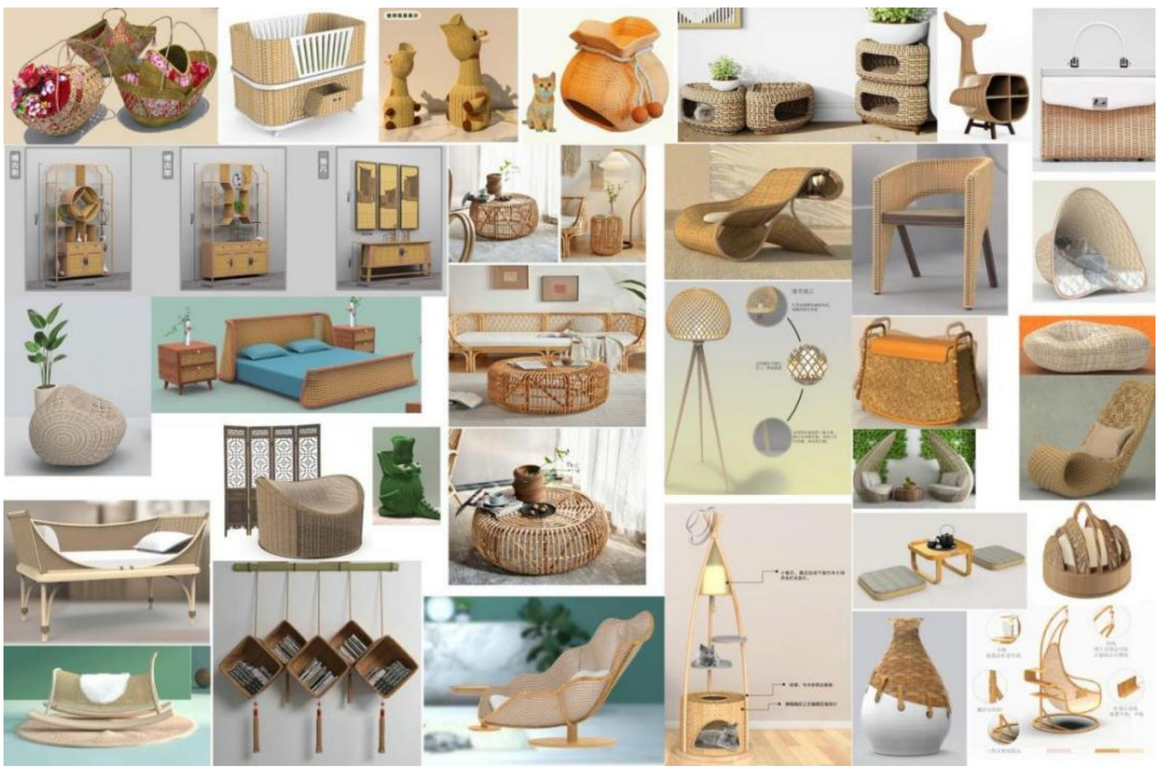

Fig. 2. Willow Woven Home Products Material Library

The next step was making request cards. The study consulted relevant professionals in cat supplies design and concluded that willow weaving material posed a safety hazard to cats, making it unsuitable for use in creating cat supplies. Consequently, all cat supply design products in the material library were deleted. The designers utilized photos from the material repository to produce 34 test cards measuring 10 cm by 10 cm for the next analysis phase. The test analysis was done by a focus group including 8 graduate students in design, one design professor, and one conference facilitator.

The focus group reviewed and confirmed the experimental cards using a hierarchical classification method before rearranging their order. The samples were re-categorized and re-grouped based on design characteristics such as shape, size, function, and context of usage, creating a connection between the originally disorganized samples. The relevant cards were ultimately merged and categorized into a unified group. This process was reiterated until all the cards had been classified and there were no more left. Then the cards were organized. To goal was to create a sample card of home items created from willow weaving. Each sample was identified and processed as S1, S2, S3, S4, S5, S6, S7, S8, S9, as seen in Fig. 3.

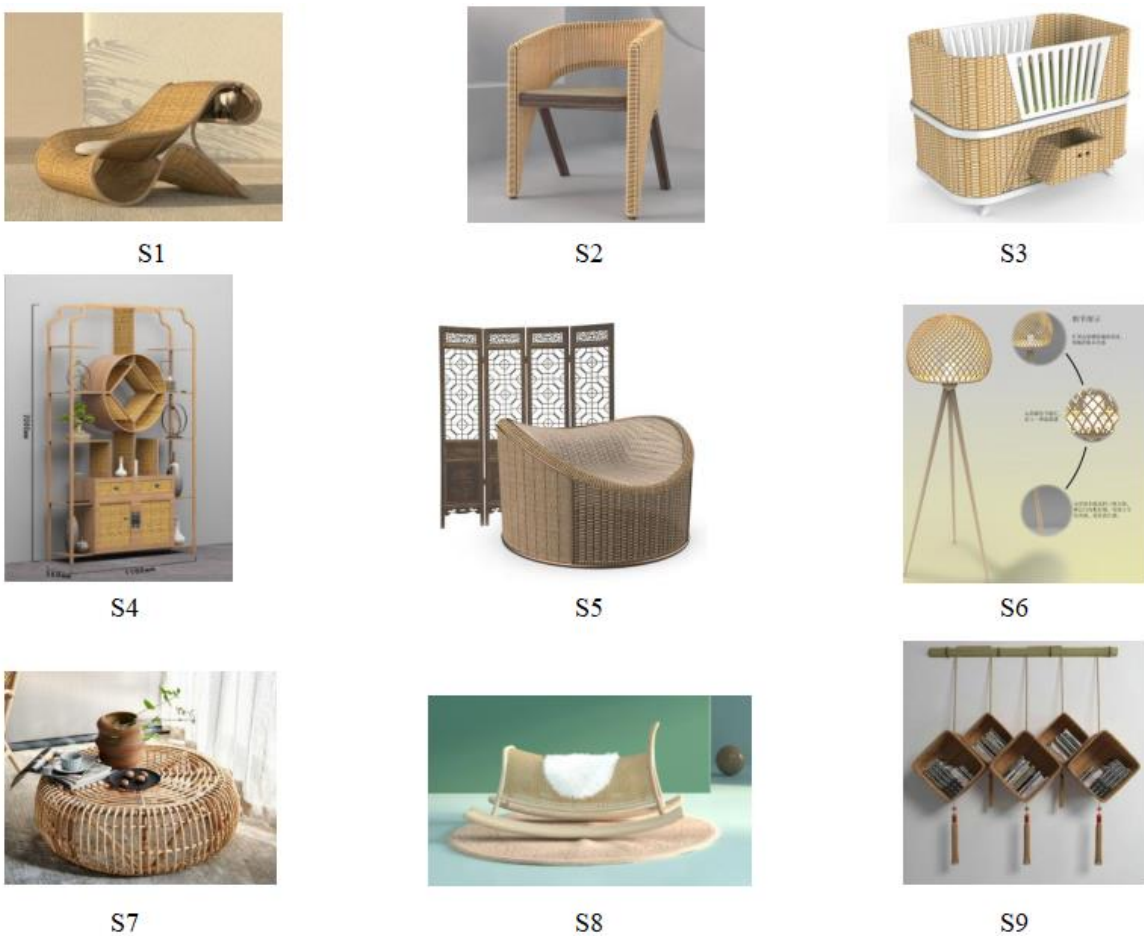

Fig. 3. Samples of typical wickerwork home products

Weights of the Factors were Calculated Using the AHP Approach

The AHP technique can prioritize several interconnected and challenging-to-differentiate choice factors based on decision objectives (Shapira and Goldenberg 2005; Yu *et al*. 2023b). This approach facilitates the making of trade-offs between decision criteria (Saaty 2008). The goal hierarchy, criterion hierarchy, and object hierarchy comprise the model's multilevel recursive structure (Darko *et al*. 2019; Xie *et al*. 2023).

The key reason for AHP's popularity is that reliable findings can be obtained without statistically significant large sample numbers (Dias and Ioannou 1996; Doloi 2008). According to Lam and Zhao (1998), since AHP is a subjective methodology dependent on expert judgments for the study of a particular problem, even the opinions of a single competent expert are typically representative (Golden *et al*. 1989; Abudayyeh *et al*. 2007; Tavares *et al*. 2008) and there is no need to use a large sample.

The minimal sample size needed for the AHP (hierarchical analysis) study is not strictly imposed. A small number of studies (Ali and Al Nsairat 2009; El-Sayegh 2009) have utilized sample sizes of more than 30, but some (Hyun *et al*. 2008; Dalal *et al*. 2010; Li and Zou 2011; Pan *et al*. 2012; Akadiri *et al*. 2013) have used sample sizes between 4 and 9. These results show that the AHP approach can still be helpful in situations with limited sample sizes, giving decision-makers meaningful models and results. Nevertheless, while calculating the AHP sample size, researchers still need to give special consideration to sample quality. A panel of specialists consisting of 8 willow weaving home product designers, 6 willow weaving product users, and 2 university professors of willow weaving home product design was invited to assist in this work.

Step 1: Create a layered recursive structural model for household goods made by willow weaving. After reading and analyzing the literature regarding willow home products, the project team discovered and filtered several characteristics that influence users' evaluations of willow home products from each article. Subsequently, field research and expert interviews on willow home product design were integrated to further arrange these influential aspects. Ultimately, a multilevel hierarchical structural model of willow home products was built using the collected data.

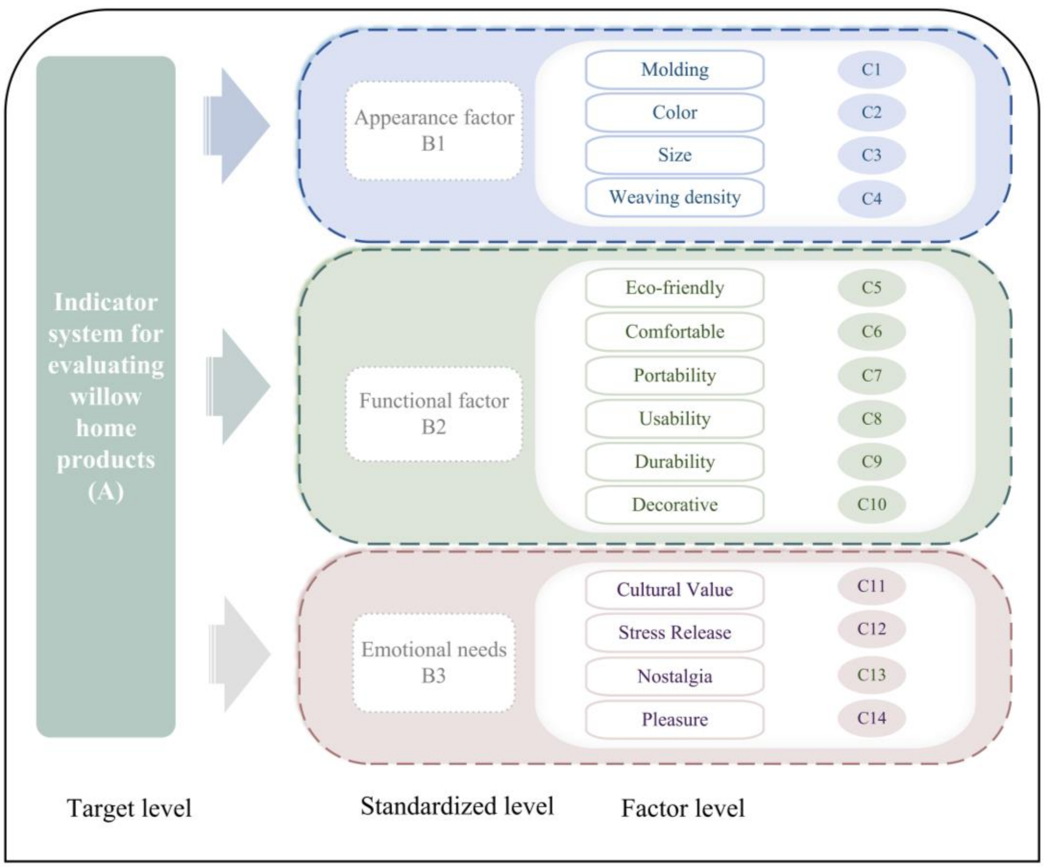

Fig. 4. Hierarchical analysis model of willow woven home products

Figure 4 displays the overall hierarchical analysis model. The evaluation index system of Willow Home Products (A) is the target layer. It consists of three criterion-level decision-making indexes: Appearance Factor (B1), Functional Factor (B2), and

Emotional Demand (B3), and there are a total of 14 element-level evaluation indexes under the three criterion-level decision-making indexes, among which the Appearance Factor (B1) corresponds to the following indexes: Molding (C1), Color (C2), Size (C3), and Weaving Density (C4); the Functional factor (B2) corresponds to the following indexes: Eco-friendly (C5), and Comfortable (C6), Portability (C7), Usability (C8), Durability (C9) and Decorative (C10); and the Emotional Demand (B3) corresponds to the following indexes: Cultural Value (C11), Stress Release (C12), Nostalgia (C13) and Pleasure (C14).

Step 2: An expert panel was asked to compare the criterion and element-level indicators using the scale technique shown in Table 1 (Wind and Saaty 1980). The data were averaged to create judgment matrices for the indicators at each level.

Table 1. 1-9 Degree Scale

Fuzzy Value	Significance
1	Equally important (EI)
3	Slightly Important (WMI)
5	Significantly important (SMI)
7	Very significant (VSMI)
9	Extremely important (AMI)
2、4、6、8	In the middle of the judgment scale

Step 3: Calculate the relative importance of the Class I and II indicators to the corresponding factors in the previous level, assign them weights accordingly, and rank them. Next, use Equations (1) and (2) to perform a consistency test and determine the consistency index, or C:

(1) Consistent judgment aims to eliminate inconsistent scoring values and verify the scientific accuracy of scoring. Consistency test needs to calculate the maximum eigenvalue λ_{max} first, according to Eq. 1 can find the maximum eigenvalue λ_{max};

$$\lambda_{max} = \sum_{i=1}^{n} \frac{[AW]_i}{n w_i} \tag{1}$$

(2) Then, calculate the consistency index CI,

$$CI = \frac{(\lambda - n)}{(n-1)} \tag{2}$$

where λ is the maximum eigenvalue λ_{max} calculated in the previous step and n is the order of the judgment matrix;

(3) The random consistency ratio (*RI*) is then applied to the test, and the random consistency index (*RI*) is found by searching the table based on matrix order.

Table 2. Consistency Test RI chart

Matrix Order	RI
1	0
2	0
3	0.52

4	0.89
5	1.12
6	1.26
7	1.36
8	1.41
9	1.46
10	0.49
11	0.52
12	1.54
13	1.56
14	1.58
15	1.59

(4) Calculated the consistency ratio *CR*,

$$CR = \frac{CI}{RI} \tag{3}$$

The results from Eq. 3 are compared to 0.1. If $CR<0.1$, then the consistency test has been passed (Saaty 2001). Otherwise, modifications and a retest of the matrix mentioned above are necessary.

Step 4: To produce subjective weight values, the data are normalized using the sum and product approach, and the hierarchical total weights are ranked. Higher weight values indicate a higher importance of the indicator.

Calculation of Indicator Weights for the CRITIC Method

CRITIC is an objective weighting method for evaluation indicators proposed by Diakoulaki (1995). It is based on the comparative intensity and conflictability indicators of evaluation indicators to synthesize the objective weights of indicators (Krishnan *et al*. 2020; Peng *et al*. 2020). The standard deviation is used to represent the comparative intensity (Vujičić *et al.* 2017); the correlation coefficient is used to represent the conflictability (Durmaz *et al*. 2020); and the comparative intensity is multiplied with the conflictiveness indicator and normalized to obtain the final weights.

The study employed a questionnaire to gather data. The participants of this experiment were recruited from students and staff aged 18 to 35 in Nanjing Forestry University, and the survey questionnaire was mainly distributed through WeChat, Questionnaire Star, and other online platforms. To assure the validity of the responses, participants had to complete our electronic questionnaire in a private, peaceful setting with no interruptions and were required to answer the questionnaire in no less than six minutes to ensure the validity of the answers.

The questionnaire consisted of three parts. The first part dealt with the subject's basic information, including gender, age, educational background. The second part was the subjective evaluation of the Willow home products. Each sample corresponded to 14 subjective evaluation indexes through the display of the sample's picture. Participants were invited to score the 14 indexes of the nine samples using a percentage system (0 to 20 means immensely dislike, 21 to 40 means less dislike, 41 to 60 indicates general favoritism, 61 to 80 indicates more favoritism, and 81 to 100 indicates great favoritism); the third part is the comprehensive evaluation, in which the subjects rank the overall favoritism among the nine design options according to their subjective feelings.

The data results from the questionnaire were averaged to obtain the initial judgment matrix table.

Step 1: Construct the decision matrix;

Using the available matrix Eq. 4 to construct the decision matrix,

$$x = [x_{ij}] = \begin{bmatrix} X_{11} & \cdots & X_{1n} \\ \cdots & \cdots & \cdots \\ X_{m1} & \cdots & X_{mn} \end{bmatrix} \tag{4}$$

Included among these, $i = 1, 2, 3, 4, \ldots, m$ and $j = 1, 2, 3, 4, \ldots, n$.

In the matrix above, the indicator scoring under each sample is represented.

Step 2: Construct the normalized decision matrix;

To eliminate the influence on the evaluation results due to the difference in the scale, the indicators are dimensionless through Eq. 5, also known as the normalization process.

$$X_{i\hat{j}} = \frac{X_{ij} - \min(X_{ij})}{\max(X_{ij}) - \min(X_{ij})} \tag{5}$$

Included among these, $i = 1, 2, 3, 4, \ldots, m$ and $j = 1, 2, 3, 4, \ldots, n$.

Step 3: Correlation coefficient of the metrics;

The correlation coefficient ρ_{jk} indicates the correlation between indicators, and ρ_{jk} is calculated through Eq. 6. A higher correlation coefficient indicates a stronger correlation with other indicators. This may diminish the evaluation strength of the indicator, and hence, the weight provided to the indication should be decreased.

$$\rho_{jk} = \frac{\sum_{i=1}^{m}}{\sqrt{\left(\sum_{i=1}^{m}(r_{ij} - \Gamma'_j)^\wedge 2 \sum_{i=1}^{m}(r_{ik} - \Gamma'_k)\right)}} \tag{6}$$

Step 4: Calculate the conflict metric;

Calculate the conflict metric of the evaluation indicators through Eq. 7.

$$C_j = \left(\sum_{j'=1}^{n}(1 - r'_{jj})\right) \tag{7}$$

As Cj increases, the importance of the j^{th} assessment indicator in the entire evaluation system also increases, requiring a higher weight to be allocated to it.

Step 5: Determine the objective weights;

Finally, the objective weights of the parameters are determined by the given Eq. 8.

$$W_j = \frac{C_j}{\sum_{j=1}^{n} C_j} \tag{8}$$

Composite Weighting Calculation

A combination of the AHP method and the CRITIC method was used to calculate the subjective and objective portfolio weights W_i; the formula is shown in Eq. 9.

$$S_i = \frac{W_i \times W_j}{\sum_{i=1}^{n} W_i \times W_j} \tag{9}$$

TOPSIS Methodology Integrated Evaluation Program

The TOPSIS approach, often referred to as the "Approximate Ideal Solution Ranking Method," is an assessment technique that ranks things based on their distance to an ideal objective, as proposed by K. Yoon in 1980. This approach assesses each sample's proximity to the idealized solution by comparing its distance to the positive ideal solution and the negative ideal solution (Behzadian *et al*. 2012). The choices are rated based on performance scores, and the optimal solution is selected. The precise stages are outlined as follows (Hwang and Yoon 2012):

Step 1: Calculate the normalization matrix; normalize the data by normalizing the data processing through Eq. 10 to derive the normalization matrix that

$$R_{ij} = \frac{X_{ij}}{\sqrt{\sum_{i=1}^{n} (x_{ij})^{\wedge}2}} \tag{10}$$

Step 2: Construct the weighted normalization decision matrix;

The weighted normalization matrix V is obtained through Eq. 11. where W_j represents the weight vector of each evaluation index, R represents the normalization matrix, and the normalization matrix V is obtained by multiplying the two.

$$V = V_{ij} = S_i * R_{ij} \tag{11}$$

Step 3: Construct positive and negative ideal solutions;

A positive ideal solution means that each indicator reaches the most desirable data value in the program, and a negative ideal solution means that each indicator is the least desirable value in the sample.

$$D^{+} = \sqrt{\sum_{J=1}^{n} (V_{ij} - V^{+})^2} \tag{12}$$

$$D^{-} = \sqrt{\sum_{J=1}^{n} (V_{ij} - V^{-})^2} \tag{13}$$

Step 4: Calculate the proximity of the height of the distance to the positive and negative ideal solutions to the ideal point for each scheme:

$$P_i = \frac{Si^{-}}{(Si^{+} + Si^{-})} \tag{14}$$

The values range from 0 to 1, with values closer to 1 indicating a higher program score.

RESULTS AND DISCUSSION

AHP Calculation Results

The judgment matrix of the target layer is shown in Table 3 after calculation. The subjective weight value for emotional needs B3 was the greatest at 49.3%, far surpassing the values of the other two standard layers. Function component B2 had a subjective weight value of 19.6%, whereas appearance element B1 was rated at 31.1%. The analysis shows that the visual aspect is more important than the functionality, and consumers' emotional desires for willow household goods are the most crucial.

Tables 4 through 6 provide the judgment matrix for criterion-level, and CR is determined by the consistency test. The test results are shown in Table 7, with a consistency ratio (CR) below 0.10. The judgment matrix's consistency test has been successful, validating the data's correctness and enabling it to be used as the basis for additional analysis. The data in Table 8 are organized and calculated, the weight value W_j of the subjective indicator system is determined, and the overall weight of the hierarchy is established.

Stress relief had the highest subjective weight of the 14 elemental layers, at 18.0%, followed by pleasure and weave fineness at 16.2% and 13.2%, respectively, and shape, color, and cultural connotations, tied for fourth. Other elements were subjectively weighted in the following order: Decorative (C10) > Comforts (C6) > Nostalgia (C13) > Usability (C8) > Durability (C9) > Eco-friendly (C5) > Portability (C7).

Table 3. A Target Layer Judgment Matrix

A	B1	B2	B3	Weights
Appearance Factor B1	1	2	1/2	0.311
Functionality Factor B2	1/2	1	1/2	0.196
Emotional Needs B3	2	2	1	0.493

Table 4. B1 Target Layer Judgment Matrix

B1	C1	C2	C3	C4	Weights
Molding C1	1	2	1	1/2	0.227
Color C2	1/2	1	2	1/2	0.227
Size C3	1	1/2	1	1/3	0.122
Weaving Fineness C4	2	2	3	1	0.423

Table 5. B2 Target Layer Judgment Matrix

B2	C5	C6	C7	C8	C9	C10	Weights
Eco-friendly C5	1	1/4	1/2	1/2	2	1/2	0.094
Comforts C6	4	1	2	1	3	1	0.255
Portability C7	2	1/2	1	1/4	1/2	1/4	0.084
Usability C8	2	1	4	1	1	1/2	0.189
Durable C9	1/2	1/3	2	1	1	1/2	0.111
Decorative C10	2	1	4	2	2	1	0.267

Table 6. B3 Target Layer Judgment Matrix

B3	C11	C12	C13	C14	Weights
Cultural Value C11	1	1/3	2	1/3	0.144
Stress Relief C12	3	1	3	2	0.432
Nostalgia C13	1/2	1/3	1	1/4	0.095
Pleasure C14	3	1/2	4	1	0.329

Table 7. Consistency Test *CR* chart

n	A	B1	B2	B3	Total
CR	0.047	0.003	0.083	0.049	0.044

Table 8. Weight Value of Subjective Evaluation Index System

A	B	Average weight (*W*′)	W_i	Sort
Appearance Factor B1	Molding C1	0.227	0.071	4
	Color C2	0.227	0.071	4
	Size C3	0.122	0.038	8
	Weaving Fineness C4	0.423	0.132	3
Functionality Factor B2	Eco-friendly C5	0.094	0.018	11
	Comforts C6	0.255	0.050	6
	Portability C7	0.084	0.016	12
	Usability C8	0.189	0.037	9
	Durable C9	0.111	0.022	10
	Decorative C10	0.267	0.052	5
Emotional Needs B3	Cultural Value C11	0.144	0.071	4
	Stress Relief C12	0.432	0.180	1
	Nostalgia C13	0.095	0.047	7
	Pleasure C14	0.329	0.162	2

CRITIC Calculation Results

The experiment got 193 returned questionnaires, excluding 11 invalid questionnaires, to collect 182 valid ones. The data from the questionnaires were averaged to obtain the initial judgment matrix, as shown in Table 9. Equation 6 was applied to the above decision matrix to obtain the normalized decision matrix, as shown in Table 10. Equation 7 was applied to the data in Table 3 above to obtain the value of the correlation coefficient, as shown in Table 10. Based on this, the value of the conflict metric is obtained by calculating Eq. 8, which in turn leads to the amount of information. Based on these values, we calculate the standardized objective weights based on the conflict measure and the amount of information, as shown in Table 11.

Total Weight Calculation Results

Both subjective and objective weights were considered while calculating the final weights. The results showed that C11 (Cultural Value) ranked fourth, C2 (Color), C1 (Molding), and C6 (Comforts) ranked fifth, sixth, and seventh, respectively; C10 (Decorative) and C13 (Nostalgia) tied for eighth; C8 (Usability) and C3 (Size) ranked ninth and tenth, respectively; C5 (Eco-friendly) and C9 (Durability) tied for eleventh; and C7 (Portability) ranked last. C4 (Weaving Fineness) had the highest final weight value, followed by C12 (Stress Relief) at 15.6% and C14 (Pleasure) at 12.2%. This demonstrates that the finest quality of willow products is their acceptable density of preparation.

Table 9. Initial Judgment Matrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
S1	66	53	49	69	84	69	44	72	65	68	69	69	70	62
S2	82	74	73	55	79	68	59	76	52	87	76	74	76	74
S3	67	65	72	83	78	64	76	78	70	60	58	52	63	64
S4	80	71	76	77	80	71	41	81	75	82	86	69	82	78
S5	54	49	58	66	82	68	46	53	70	47	61	40	73	56
S6	82	78	74	62	83	70	59	74	57	84	78	76	71	73
S7	74	72	72	76	77	72	67	75	74	69	66	75	76	72
S8	81	72	75	74	80	82	83	77	72	77	73	82	75	81
S9	86	74	70	78	82	82	75	62	75	82	84	73	75	77

Table 10. Normalized Matrix Table

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
S1	0.375	0.138	0.000	0.500	1.000	0.278	0.071	0.679	0.565	0.525	0.393	0.690	0.368	0.240
S2	0.875	0.862	0.889	0.000	0.286	0.222	0.429	0.821	0.000	1.000	0.643	0.810	0.684	0.720
S3	0.406	0.552	0.852	1.000	0.143	0.000	0.833	0.893	0.783	0.325	0.000	0.286	0.000	0.320
S4	0.813	0.759	1.000	0.786	0.429	0.389	0.000	1.000	1.000	0.875	1.000	0.690	1.000	0.880
S5	0.000	0.000	0.333	0.393	0.714	0.222	0.119	0.000	0.783	0.000	0.107	0.000	0.526	0.000
S6	0.875	1.000	0.926	0.250	0.857	0.333	0.429	0.750	0.217	0.925	0.714	0.857	0.421	0.680
S7	0.625	0.793	0.852	0.750	0.000	0.444	0.619	0.786	0.957	0.550	0.286	0.833	0.684	0.640
S8	0.844	0.793	0.963	0.679	0.429	1.000	1.000	0.857	0.870	0.750	0.536	1.000	0.632	1.000
S9	1.000	0.862	0.778	0.821	0.714	1.000	0.810	0.321	1.000	0.875	0.929	0.786	0.632	0.840

Table 11. Weights of Objective Evaluation Indicators

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
Measure of conflict	6.225	6.917	8.073	12.085	15.449	7.968	10.327	9.943	12.352	7.107	7.522	7.085	9.601	5.832
Quantity of Information (CJ)	2.024	2.394	2.727	3.827	5.189	2.753	3.752	3.156	4.427	2.334	2.608	2.241	2.639	1.941
Wj	0.048	0.057	0.065	0.091	0.124	0.066	0.089	0.075	0.105	0.056	0.062	0.053	0.063	0.046

Table 12. Table of Total Weight Values

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
Wi	0.071	0.071	0.038	0.132	0.018	0.050	0.016	0.037	0.022	0.052	0.071	0.180	0.047	0.162
Wj	0.048	0.057	0.065	0.091	0.124	0.066	0.089	0.075	0.105	0.056	0.062	0.053	0.063	0.046
Si	0.056	0.066	0.040	0.196	0.036	0.054	0.023	0.045	0.038	0.048	0.072	0.156	0.048	0.122
Sort	6	5	10	1	11	7	12	9	11	8	4	2	8	3

TOPSIS Calculation Results

The TOPSIS comprehensive evaluation's final evaluation scores are displayed in Table 13. The final rankings, ranked in descending order based on the relative progress of the posting, are S9>S8>S4>S7>S3>S6>S1>S7>S5, at the same time, based on the answers to the final section of the questionnaire, the user's preference for the nine design options is S9>S4>S8>S7>S6>S3>S7>S1>S5, and combining the two leads to the conclusion that option 9 is the best course of action.

Table 13. Relative Proximity of Programs

Sample	Positive ideal solution distance D+	Negative ideal solution distance D-	Relative proximity C	Sorting results
S1	0.09	0.081	0.472	7
S2	0.11	0.093	0.456	8
S3	0.093	0.111	0.543	5
S4	0.043	0.128	0.75	3
S5	0.132	0.047	0.264	9
S6	0.086	0.099	0.537	6
S7	0.056	0.115	0.672	4
S8	0.041	0.133	0.762	2
S9	0.032	0.134	0.807	1

DISCUSSION

Using the Analytic Hierarchy Process (AHP) within a standard hierarchical framework, the priority order of contributing criteria for designing willow household items was established. Emotional needs were deemed more crucial than appearance factors, which in turn were considered more significant than functional aspects. Specifically, the aesthetic design of willow-weaving home products was emphasized over their utilitarian design.

In the 14-factor hierarchy, the weights of the first 4 influential factors in willow weaving home product design, determined through the Analytic Hierarchy Process (AHP) and CRITIC comprehensive weight calculation, are ranked as follows: Weaving Density > Stress Relief > Pleasure > Cultural Value. This rating offers a distinct design orientation and emphasis for willow home product design. The future success of willow home furnishing enterprises depends on inventing weaving processes, discovering cultural importance, improving visibility, generating emotional connections, and daring to innovate while pursuing optimum solutions.

The TOPSIS method pinpointed the optimal design for willow weaving household products by comparing evaluation scores, ultimately favoring scheme nine as the prime choice. Scrutinizing the aspects of this exemplary scheme yielded valuable insights for expanding new markets in willow weaving home furnishings. This model facilitated the efficient creation of an evaluation system, ensuring designers consistently capture the core essence of Funan willow weaving products. It curbs the drift caused by empiricism, and it ensures objective evaluation and precise selection of design solutions.

There is value to be gained from investing in scientific and technological research and development to explore innovation and upgrading in the willow weaving industry to enhance product quality. Additionally, mathematical modeling should be integrated with computer-aided design (CAD), 3D printing, and other technologies to create willow weavings (Wang *et al*. 2023b,c; Xu *et al*. 2023). Such digital design can achieve more intricate and delicate weaving effects by carefully controlling the wicker's position and angle (Zheng and Zhu 2021). Furthermore, to fulfill the demands of consumers at all levels, improved production efficiency and product quality are achieved by introducing new production equipment and process technology. It is essential to prioritize environmental concerns and sustainable practices throughout the entire process of sourcing raw materials, manufacturing products, and delivering finished goods (Boran *et al*. 2013; Ali *et al*. 2022). Utilizing recyclable, natural, and biodegradable materials is crucial for advancing the willow weaving craft in a more eco-friendly and sustainable direction (Aisyah *et al.* 2021). This approach aligns with modern societal ideals and adds a fresh, contemporary meaning to willow-weaving items.

Funan willow-weaving household enterprises can benefit from engaging young consumers and implementing industrial upgrades and transformations in the current era. This will lead to the innovative and sustainable development of the Funan willow-weaving household industry. The sample collection for this study primarily consists of individuals from the young age group. Furthermore, the survey participants' characteristics, including education level, gender, and geographic region, can impact users' preferred decisions. Future research should increase the sample size to gather user preferences from all age groups for more precise and reliable results. Promoting design innovation in traditional willow weaving items can significantly enhance local inhabitants' income, facilitate economic change, and support preserving and promoting traditional skills and culture. Those in the business may create new goods that better align with market demands by delving further into users' requirements and preferences.

CONCLUSIONS

1. To improve chances for future market success, willow-weaving home product enterprises should thoroughly explore the historical origins, cultural significance, and traditional willow weaving techniques. They should connect these aspects with local folk cultural traditions, festivals, and customs to highlight their importance and role in traditional culture. The cultural elements were found in this work to be the primary competitive advantage of the firm and the cultural basis of the enterprise brand (Wang *et al*. 2019). Simultaneously, brand building and marketing promotion tailored to the city's characteristics and user needs (Chen 2021), such as brand storytelling, cultural heritage promotion, and social welfare activities, aim to evoke emotional resonance, strengthen the enterprise's connection to local culture, enhance humanistic care, and boost brand recognition. This strategy establishes the willow home furnishing enterprise as a regionally distinctive and culturally significant brand.
2. By merging traditional willow weaving methods with modern aesthetics and market needs (Zheng and Zhu 2021), while preserving unique cultural traits (Zhang and Tsai 2021), utilizing modern technology, and incorporating contemporary creativity and design, the traditional craft will be passed down in a novel manner, fostering its sustainable development. By integrating ancient traditional crafts with modern techniques and design, as well as addressing current life and fashion requirements, the goal is to rejuvenate these crafts through contemporary modes of expression and

consistently elevate the cultural significance of willow weaving goods. Incorporate contemporary market awareness to broaden the sales market of willow home products by diversifying product offerings within a reasonable scope. This will align the products with current aesthetic preferences and modern lifestyles, extending beyond furniture to include lamps, ornaments, and other decorative items. The design of wicker household items reflects the peculiarities and appeal of a specific lifestyle, highlighting the importance of traditional handicrafts in contemporary culture.

3. It is recommended to enhance talent training and skill inheritance to establish a team of specialists in the willow weaving industry and advance the preservation and growth of traditional crafts. The "integration of production, study, and research" approach can be enhanced to improve the current teaching system for sustainable growth of willow weaving abilities by focusing on research, innovation, and creativity to gain consumer market awareness. By promoting the "non-heritage into campus" activity, there is an opportunity to enhance collaboration between schools and businesses (Lee 2005), conduct training and skill competitions, and partner with willow weavers to engage more young individuals in designing willow-weaving household items. This will help comprehend the specific requirements of young people, particularly the millennial generation. The goal is to develop new willow household goods that are modern, high-quality, and crafted with great skill.
4. It is recommended to proactively in industrial cooperation development, enhance collaboration and interaction with connected local industries, and establish industrial cluster effects. Collaboration with local tourism, cultural creativity, handicrafts, and other industries has potential to boost the overall competitiveness of local cultural industries and collectively advance the development of local distinctive cultural sectors (Sohn 1997). Cultural innovation can drive local economic growth by boosting the cultural spread of Funan willow weaving firms, improving the living standards of local people, and contributing to social advancement.

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