Research on Willow Furniture Design Based on Kano-AHP and TRIZ

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Willow wood furniture has become one of the most popular types of wood furniture in the Chinese furniture market. Research was undertaken to solve the pain points of product design and meet the requirements of green development. Firstly, the Kano model was used to classify user requirements. Secondly, the Analytic Hierarchy Process was used to calculate each design factors' comprehensive weights, ensuring consistency between the design objectives and user requirements. Thirdly, the TRIZ contradiction matrix was used to identify and solve engineering difficulties in the design process. During the design process, the Kano-AHP-TRIZ was combined to realize a scientific design strategy that combines qualitative and quantitative approaches. The results showed that the design scheme of willow furniture based on user requirements had consistency, matching, and effectiveness with the furniture market development trend, which makes the furniture design process more scientific and rigorous. It also provided a new research perspective and design strategy for the innovative development of the furniture industry.

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INTRODUCTION

In the early stage of development, the Chinese furniture industry followed the international style represented by Italy for a long time, and most enterprises were keen on imitation and paid less attention to innovation (Xu 2024). In the international furniture industry, the core element of competition focuses on innovative design, which is essentially a deep competition for furniture innovative capabilities. The traditional approach taken in the Chinese furniture industry has been to gradually shape and developing unique design styles. "New Chinese style" is a designer's exploration of the modernization of traditional Chinese furniture, which is of positive significance to the promotion of national culture and the development of original Chinese furniture (Zhang *et al*. 2022). In recent years, willow weaving has received more attention as an important branch of traditional folk art (Zhou *et al*. 2018). Integrating willow weaving into furniture design can improve the social and cultural value of furniture.

Willow weaving is an important form of willow furniture, and its main material is the branches of trees such as *Salix babylonica*, *Salix chaenomeloides*, *Salix integra* (Latin nomenclature), and so on. Willow has the characteristics of being natural, free of pollution, renewable, and widely used in green household products (Cui 2020). The combination of willow and traditional Chinese handicrafts also gives the furniture a unique artistic value.

Wu and Wang (2020) combined willow weaving technology and sofas to integrate modern product design concepts into the design, and they proposed a green innovative design method that conforms to modern aesthetics. Wang (2023) took the willow round-backed armchair as the research object and analyzed the design advantages and disadvantages of willow circle chair products, which provided a theoretical basis for the inheritance and development of traditional handicrafts. The combination of modern aesthetics and traditional craftsmanship provides a new research perspective for furniture innovation. Yu *et al*. (2023) researched a number of willow furniture enterprises and applied the combination of willow craftsmanship and modern technology to furniture design, which broadened the ideas for the innovative design of willow furniture. The innovative application of willow weaving in furniture is the inheritance of traditional culture and the deep integration of modern lifestyle.

Currently, in the environment of diversification and personalization of user requirements, emotional requirements become more and more important in the customer's decision to buy products (Li *et al*. 2021). The Kano model is an analysis method used for product design and user requirement capture. Taifa and Desai (2016) and Kapuria *et al.* (2020) used the Kano model to analyze students' demand, satisfaction, and demand classification for existing classroom furniture. Their scientifically effective redesign of classroom furniture has gained recognition from people. Lyu *et al*. (2022) used the Kano model to analyze the problems that users encountered in the office and combined it with QFD to translate the users' needs into rules in the development of office furniture, which facilitates the development and design of furniture in an open-plan office scenario. This integrated modeling approach also provides a new research strategy for other furniture designs. The Kano model can effectively solve the problem of categorizing and ranking the importance of user requirements, but differences in user perception can lead to decision-making hesitation between demand attributes. This type of user perception difference requires a scientific evaluation method for quantitative analysis. Analytic Hierarchy Process (AHP), as a combination of qualitative and quantitative analysis methods, can solve the problem of user perception difference requirements. Liu *et al*. (2023) used AHP and F-AHP to establish an evaluation system for dining chair design, which provided designers with design priorities and quantitative indicators. Zhao and Xu (2023) used the Kano model to screen the functional indicators and proposed an evaluation method for modular children's wooden locker furniture design by combining AHP and GRA, providing a new innovative idea for children's furniture manufacturers. Wang and Fan (2024) used the Kano model to determine the user requirements of shoe-changing seats for the elderly, and combined AHP and QFD to comprehensively rank the relative importance of the design elements, which provided a new research idea for the development of suitable aging furniture. The combination of AHP and Kano can effectively solve the problem of comprehensive ranking of demand indicators, user requirement weighting analysis, and obtaining real user requirements for subsequent design.

User requirements are emotional and changeable, so inaccurate acquisition will affect the subsequent design program. Teoriya Resheniya Izobreatelskikh Zadatch (TRIZ) is a methodology for solving practical problems using scientific and rigorous methods. It provides a systematic approach to finding solutions to technical problems and innovating technical systems (Ilevbare *et al*. 2013), which can accurately complete design decisions based on user requirements. Yao *et al*. (2022) investigated the rapid assembly and deployment features of a folding chair, using TRIZ theory to explore the innovative design of a folding chair. Tandiono and Rau (2022) combined the Kano model with QFDE,

analyzed the contradiction problems in lamp design using TRIZ theory, and proposed solutions in the process of enterprise product development. Yi (2023) used QFD and TRIZ to analyze the contradiction points of human-pet shared furniture in terms of shape, material, color, and function, and proposed a new design scheme, which compensated for the limitations of the traditional design methods to a certain extent. The virtuous cycle of ecosystem of human-pet shared living space is realized.

Existing research has shown that Kano, AHP, and TRIZ have been widely used to acquire user requirements and refine design decisions, and their scientific, novelty, systematicity, and effectiveness have been proved through long-term practical validation. The combination of Kano, AHP, and TRIZ can effectively shorten the product development cycle and save the product development cost. This research aims to explore innovative willow wood furniture using Kano-AHP-TRIZ. This furniture can satisfy users' requirements, improve users' aesthetic level and user experience, and provide a new realization path for the optimization and improvement of the willow furniture process, as well as provide a new evaluation system, design strategy, and design method for the design innovation of willow furniture and other related products, to promote the differentiation and competitiveness of furniture products.

EXPERIMENTAL

Experimental Processes

The changes in living environment and lifestyle make people's consumption ideas and consumption behavior tend toward the rational (Xiong *et al*. 2017). Designers relying solely on product attribute satisfaction to obtain real user requirements have limitations, and they also are required to make the design process more scientific and rigorous. Therefore, this study takes the willow sofa as an example to organize a willow furniture design process that combines the Kano-AHP-TRIZ theory.

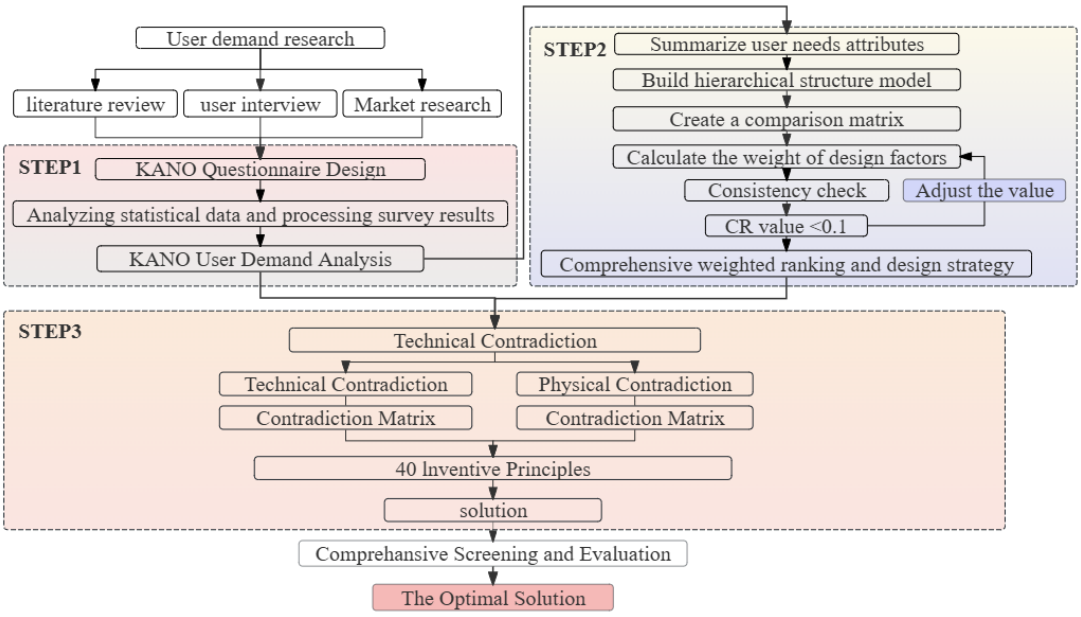

Fig. 1. Flowchart of experimental process

Through the methods of user interviews and market research, the Kano model was used to get the user's functional requirements for the sofa, and then combined with the AHP to determine the priority level of the functional design of the furniture and come up with the problems that requirement to be solved for the willow sofa. Finally, the invention principle of TRIZ theory is used to solve the contradictions generated in the design process, to obtain a complete willow sofa design scheme. The specific experimental process is illustrated in Fig. 1.

Design evaluation for furniture is mainly inextricably linked to consumers' purchase decisions, so integrating consumers into design decisions is a wise decision (Zhao and Xu 2023). For this reason, users were invited to score for evaluation at the end of the experiment to finalize the feasibility of the design solution.

Construct the Kano Model

The Kano model offers a better understanding of how customers evaluate a product. Thus, this can be used to assist enterprises in focusing on the improvement of the most important attributes (Ilevbare *et al*. 2013). The Kano model can be categorized according to the requirements: must-be requirements, one-dimensional requirements, attractive requirements, indifference requirements, and reverse requirements. Anhui Funan is one of the three major production and export bases for willow products in China. In this work, interviews were conducted with local willow weaving manufacturing enterprises to understand the current development status of willow furniture products and discuss how to innovate the design of willow furniture. The research revealed that users use sofas most frequently in their homes, and for this reason, the focus of this work became the design of willow sofas. Under the guidance of professionals, the Willow Sofa is targeted at the 30 to 50 age group. These users have high demands for quality of life and have a certain purchasing power. After the target user and the product have been identified, user requirements are categorized according to the basic functions of the sofa: functionality, appearance, and emotion. Detailed requirements are shown in Table 1.

Table 1. User Requirements Segmentation Table

Number	User Requirement	Attribute	Number	User Requirement	Attribute
A1	Storage	Function	A11	Lumbar Support	Function
A2	Back Regulation	Function	B1	Warmth	Emotion
A3	Modularization	Function	B2	Security	Emotion
A4	Easier Installation	Function	B3	Interesting	Emotion
A5	Easy Washing	Function	C1	Organic Forms	Appearance
A6	Desk Board	Function	C2	Modern Style	Appearance
A7	Health Massage	Function	C3	Human-machine Engineering	Appearance
A8	Entertainment Function	Function	C4	Crude Wood	Appearance
A9	Easy Moving	Function	C5	Harmonious Proportion	Appearance
A10	Head Support	Function	C6	Composite Material	Appearance

Design and Analysis Questionnaire

The design team conducted a Kano questionnaire survey at recent furniture exhibitions and online, distributing a total of 110 questionnaires (97 valid and 13 invalid),

with a final effective recovery rate of 88.1%. Among them, 50 questionnaires were distributed to visitors and resident designers at the furniture exhibition, and 47 were effectively collected. We continued to distribute 60 questionnaires online to have a more comprehensive coverage of our target users, with 50 effective responses.

Analysis Satisfaction

According to the Kano model, the user quality requirements in the early stages of design can be clearly classified into different attribute types through a two-factor questionnaire survey comparison table. (M) must-be requirement, (O) one-dimensional requirement, (A) attractive requirement, (I) indifference requirement, and (R) reverse requirement. The Better-Worse coefficient was then used to analyze each functional requirement indicator, calculating its satisfaction coefficient and dissatisfaction coefficient. The specific value was calculated by (Zhao and Chen 2021) using Eqs. 1 and 2.

$$BETTER(SI) = \frac{(A+O)}{(A+O+M+I)} \quad (1)$$

$$WORSE(DSI) = \frac{(-1)*(O+M)}{(A+O+M+I)} \quad (2)$$

The results obtained by combining the Kano models were tabulated. The user requirement attribute categorization and satisfaction coefficients are shown in Table 2.

Table 2. User Requirement Attributes and Satisfaction Coefficients

Number	M	A	O	I	R	Attribute	SI	DSI
A1	10	23	42	23	0	A	0.67	-0.34
A2	10	25	26	35	1	I	0.531	-0.365
A3	15	25	36	19	2	A	0.642	-0.421
A4	39	21	20	17	0	M	0.423	-0.619
A5	24	43	20	10	0	O	0.649	-0.69
A6	8	25	37	25	1	A	0.656	-0.343
A7	12	24	25	35	1	I	0.51	-0.375
A8	3	17	21	23	33	R	0.594	-0.313
A9	19	16	23	39	0	I	0.402	-0.361
A10	16	29	33	19	0	A	0.639	-0.464
A11	13	26	35	23	0	A	0.63	-0.402
B1	17	46	24	9	1	O	0.729	-0.656
B2	43	20	25	9	0	M	0.464	-0.649
B3	13	21	26	36	1	I	0.49	-0.354
C1	21	21	16	37	2	I	0.389	-0.442
C2	19	36	28	12	2	O	0.674	-0.579
C3	47	26	24	0	0	M	0.515	-0.753
C4	18	42	27	10	0	O	0.711	-0.619
C5	26	39	29	3	0	O	0.701	-0.67
C6	13	21	38	24	1	A	0.615	-0.354

Note: M. A, O, I, and R represent Must-be Requirement, Attractive Requirement, One-dimensional Requirement, Indifferent Requirement, and Reverse Requirement, respectively.

A scatter plot of user demand elements was drawn based on the average of the 20 demand elements satisfaction SI and |DSI| in Table 2 (0.5, 0.6) as the origin of the horizontal and vertical coordinates, as shown in Fig. 2.

Table 2 shows the situation for 20 functional attributes. When SI>0.6, |DSI|>0.5, belongs to the one-dimensional requirement, including easy washing, warmth, modern style, crude wood, and harmonious proportion of five items; when SI>0.6, |DSI|<0.5, belongs to the attractive requirement, including storage, modularization, desk board, head support, lumbar support, and composite material of six items; when SI <0.6, |DSI|<0.5, belongs to the indifference requirement, including back regulation, health massage, easy moving, entertainment function and organic forms of five items; when SI <0.6, |DSI|> 0.5, belongs to the necessary type of demand, including easy installation, security, and human-machine engineering of three items.

The next step was to draw a scatter plot based on the SI and DSI of user requirements, and determine the priority of user requirements for the willow sofa based on the distance between each demand point and the coordinate origin (0.2, 0.2). The further away the demand point is from the origin, the higher the priority of development. As can be seen from Fig. 2, the priority order of development and design is B1>C5>A5>C4>C3>C2>B2>A10>A3>A1>A6>A4>A11>C6, but due to the fact that A2, A7, B3, C1, and A9 belong to the indifference requirements, they can be disregarded for the time being in the development of the design of the willow sofa. Whereas C3, B2, and A4 are must-be requirements that must be met during design and development. Therefore, the willow sofa should mainly focus on B1, C5, A5, C4, C2, A10, A3, A1, A6, A11, and C6 in the design and development, and the improvement of the design to meet these requirements can make the product better accepted by the user and improve the user's satisfaction. The scatter plot of user requirements elements is shown in Fig. 2.

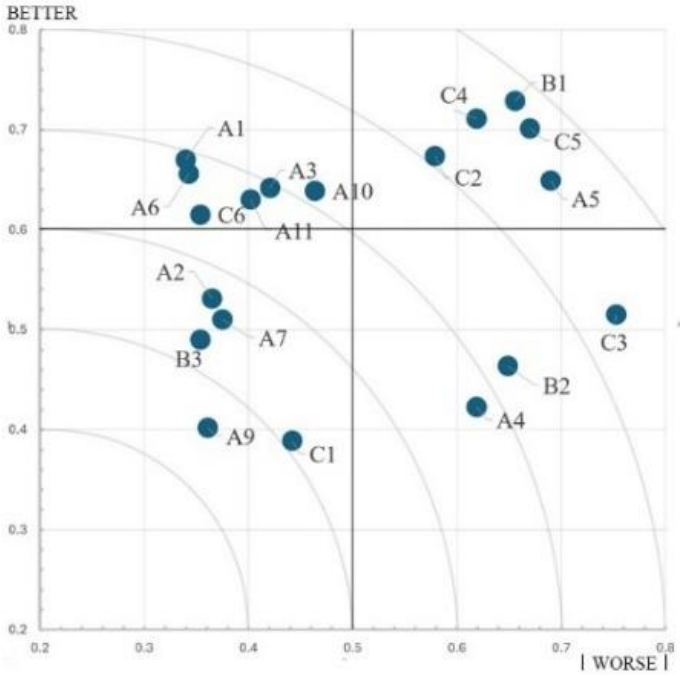

Fig. 2. The scatter plot of user requirement elements

Construct the Hierarchy Model

In order to further clarify the design focus of the willow sofa, the Analytic Hierarchy Process (AHP) was introduced to refine the results of the Kano model. It outperforms other options by being easy to use, structuring problems systematically, and calculating both criteria weights and alternative priorities (Liu *et al*. 2020). With the advantages of objectivity and convenience, AHP has been widely used in product design and development in recent years.

The design focus was determined based on the prioritization of user needs for willow sofas identified by the Kano model and the market analysis report provided by Funan willow furniture companies. The current furniture market is dominated by modern style wooden furniture, which combines the characteristics of warmth, harmonious proportion, and easy washing to form the overall trend of furniture. Therefore, during the design process, we directly satisfy the five one-dimensional requirements of ease washing, warmth, modern style, crude wood, and harmonious proportion in accordance with market standardization. And the 3 must-be requirements of easy installation, security, and human-machine engineering are directly met. Storage, modularization, desk board, head support, lumbar support, and composite materials totaling 6 attractive types of needs should be used as a design focus to increase the satisfaction of user needs and provide innovative ideas for willow furniture. These requirements were categorized into 18 design elements to serve as evaluation criteria for the willow sofa. Using the AHP, a hierarchical structure model was constructed based on these criteria. See Fig. 3. for the user requirement hierarchical structure model.

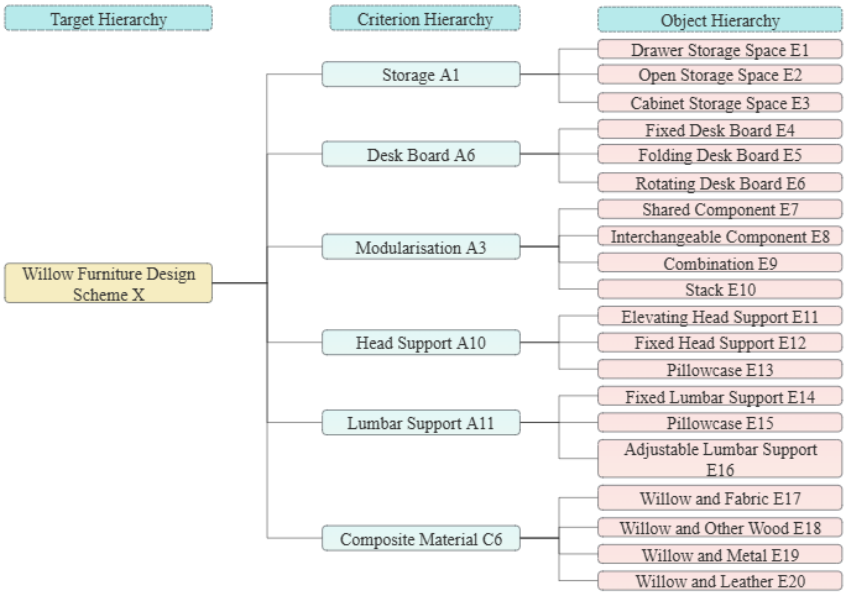

Fig. 3. The hierarchical structure model of user requirements

The team organized a panel of six experts (including three furniture designers, two professors of industrial design, and one consumer). Through Saaty's 9-point scale (Yang *et al*. 2019), the requirement categories were compared in pairs to construct the judgment matrix. The weight values were calculated using the arithmetic mean method. See Table 3 for the judgment of requirement indicator weights.

Table 3. The Judgment of Requirement Indicator Weights

X	A1	A6	A3	A10	A11	C6
A1	1.000	1.957	2.667	4.329	1.364	3.077
A6	0.511	1.000	0.238	0.391	0.300	0.370
A3	0.375	4.200	1.000	2.770	0.907	0.529
A10	0.231	2.556	0.361	1.000	0.461	0.349
C11	0.733	3.333	1.103	2.167	1.000	0.394
C6	0.325	2.700	1.889	2.867	2.538	1.000

The results were subjected to a consistency test, see the Eq. 3.

$$CR = \frac{\lambda_{\max} - n}{(n-1) \cdot RI} \quad (3)$$

where λ_{max} is the maximum characteristic of the judgment matrix, n is the matrix order, and RI is the average random consistency index. Consistency of <0.1 is required during data entry. If it is not satisfied, the data will be readjusted (Yue *et al*. 2022). According to the formula, the consistency ratio (CR) is calculated to be 0.008, passing the consistency test.

Experts were again organized to score the judgment matrix constructed at the target hierarchy. The weight values were calculated according to the arithmetic mean method, and the consistency test was calculated. CR was calculated as follows: 0.02, 0.016, 0.035, 0.016, 0.031, and 0.061, all passing the consistency test. Subsequently, the comprehensive weight values for the 18 secondary criteria layers were calculated, resulting in the final ranking of the willow sofa requirements' comprehensive weight. Table 4 shows the comprehensive weight ranking of willow sofas.

Table 4. Combined Weighted Order of Willow Weaving Sofa

Criterion Hierarchy	Weights	Object Hierarchy	Weights	Comprehensive Weights	Rank
A1	0.312	E1	0.621	0.1938	1
		E2	0.261	0.0814	5
		E3	0.118	0.0368	11
A6	0.066	E4	0.091	0.0060	20
		E5	0.616	0.0407	9
		E6	0.293	0.0193	14
A3	0.159	E7	0.105	0.0167	16
		E8	0.086	0.0137	18
		E9	0.566	0.0900	4
		E10	0.243	0.0386	10
A10	0.082	E11	0.091	0.0075	19
		E12	0.616	0.0505	6
		E13	0.293	0.0240	13
A11	0.163	E14	0.6	0.0978	3
		E15	0.282	0.0460	8
		E16	0.118	0.0192	15
C6	0.218	E17	0.544	0.1186	2
		E18	0.222	0.0484	7
		E19	0.072	0.0157	17
		E20	0.162	0.0353	12

The importance of the criterion hierarchy is ranked as A1 > C6 > A11 > A3 > A10 > A6. The composite ranking of the object hierarchy is E1 > E17 > E14 > E9 > E2 > E12 > E18 > E15 > E5 > E10 > E3 > E20 > E13 > E6 > E16 > E7 > E19 > E8 > E11 > E4. This indicates that users urgently require the storage function of furniture, which provides a systematic solution for efficient utilization of space. The diversity of modern home decoration also makes users highly value the beauty and comfort brought by composite materials. With the improvement of life, users have begun to pay attention to healthy sitting posture, head support, and lumbar support design to meet the user's health requirements.

Through the above comprehensive weighting ranking, the top 10 target hierarchy requirements will be selected as the key design guidelines to focus on problem solving. However, there are certain contradictions and conflicts in the design process of different design indexes, so it is necessary to use TRIZ theory to solve the existing technical and physical contradictions.

Use the TRIZ Theory

During the design and development process, the team uncovered the contradictory conflicts that attractive requirements (A), must-be requirements (M), one-dimensional requirements (O), and requirement weighting of the objective hierarchy would create in practical application. Firstly, reference was made to the Chinese government's "Custom furniture—Specification for installation acceptance" standard to ensure compliance with policy requirements for market development. Secondly, for the physical contradiction, drawer storage space and open storage space are categorized as space separation according to the separation principle in TRIZ theory, whose corresponding solution principles are 1, 2, 3, 4, 7, 13, 17, 24, 26, and 30. Fixed lumbar support and pillowcase are categorized as conditional separation, which corresponds to solution principles 1, 5, 6, 7, 8, 13, 14, 22, 23, 25, 27, 33, and 35. For the technical contradiction, the Improved Parameters and Deteriorating Parameters are determined according to TRIZ theory, the sofa needs to be easy to install, but the drawer storage will cause the structure to become complicated. This is a contradiction between the engineering parameter 33 (operability) and the engineering parameter 36 (complexity of device), in order to reduce the complex structure of the sofa, in accordance with Archimedes contradiction matrix, found in invention numbers 32, 26, 12 and 17. Four solutions were obtained against 40 inventive principles No.32 (Change the color), No.26 (Copying), No.12 (Equipotentiality), and No.17 (Shift to a new dimension). The ease of washing the sofa and the use of composite materials also create a contradiction between the maneuverability and complexity of the device. To reduce the complexity of the sofa's structure, four solutions have been found by the same methodology as in invention numbers No. 32, No. 26, No. 12, and No. 17. A design strategy for the willow sofa was obtained. Refer to Table 5 for physical contradiction analysis and resolution principles and Table 6 for technical contradiction analysis and resolution principles.

Table 5. Principles of Physical Contradiction Analysis and Resolution

Conflict Number	Conflict	Type of Contradiction	Separation Mode	Inventive Principle
01	Drawer storage space-Open storage space	Physical Contradiction	Space	1, 2, 3, 4, 7, 13, 17, 24, 26, 30
02	Fixed lumbar support-Pillowcase		Conditional	1, 5, 6, 7, 8, 13, 14, 22, 23, 25, 27, 33, 35

Currently, to improve the user's home comfort and maximize the use of space resources, the storage function is the user's primary demand for furniture. Items No. 1 (Segmentation) and No. 3 (Local conditions) were used to resolve the physical contradiction between drawer storage space and open storage space. Specifically, two types of storage are divided into two or more different areas to meet the basic function of the sofa while addressing the storage requirements of the user. Users require furniture to provide a better living experience for the improvement of their living standards. Lumbar support allows users to have a healthy and comfortable sitting posture when using the sofa. Items No. 5 (Consolidation), No. 6 (Universality), and No. 33 (Homogeneity) were used to resolve the physical contradiction between fixed lumbar support and pillowcases. The characteristics of the pillow and lumbar support are combined, and thereby the lumbar support has the comfort of a pillow and is fixed on the sofa to serve as a lumbar support.

Table 6. Principles of Technical Contradiction Analysis and Resolution

Conflict Number	Conflict	Type of Contradiction	Improved Parameters	Deteriorating Parameter	Inventive Principle
01	Easy installation-Drawer storage space	Technical Contradiction	No.33 Homogeneity	No.36 Phase transition	32，26，12，17
02	Easy washing - Composite Material		No.33 Homogeneity	No.36 Phase transition	

To resolve the technical contradiction between easy installation and drawer storage space, No. 26 (Copying) was used. By abandoning the complex mechanical slide structure and adopting wooden nested slides to achieve the pull-out function, the environmentally friendly drawer structure is also easier to install. To address the conflicts between easy cleaning and composite materials, No. 26 (Copying) and No. 17 (Shift to a new dimension) were used to resolve them. Specifically, use fabric materials that are easy to clean and discard complex decorative components. Willow weaving is designed in a vertical orientation as a decorative piece, with inlays to reduce dust buildup and cleaning difficulty.

RESULTS AND DISCUSSION

The final product design scheme is shown in Fig. 4. Component "a" is the head support, which is made of a memory sponge as padding and cloth fiber material on the outside. This material is comfortable, waterproof, stain-resistant, and aging-resistant. Component "b" is the backrest of the sofa. Its interior is a willow wood frame with a mixture of density and high elasticity sponge padding for optimal support and comfort. Component "c" is open storage space for increased use of storage organizers. Component "d" is a folding tabletop, designed to take into account the additional functions of the sofa, providing users with a wider range of use scenarios and realizing the diversity of functions. Component "e" is an open storage space with a composite material combining willow and cloth fibers, a design that enhances the supportive strength of the seat surface while guaranteeing structural stability. Component "f" is a willow weaving decoration that enhances the overall aesthetics of the sofa. Component "g" is the sofa base, made of white

wax wood. Its characteristics are good processing performance, toughness, and elasticity, making the sofa base sturdy and durable. Component "h" is a drawer storage space with willow weaving as a decorative element, providing users with the convenience of storing small items and books. Component "i" is the lumbar support, made of materials consistent with the head support and ergonomic, which ensures optimal lumbar cushioning and comfort for the user. Component "j" is a willow drawer, which has good breathability and aesthetics while increasing storage space. Component "k" is the stackable modular sofa armrest, designed with harmonious proportions and curves to provide arm support for users and create a serene psychological atmosphere.

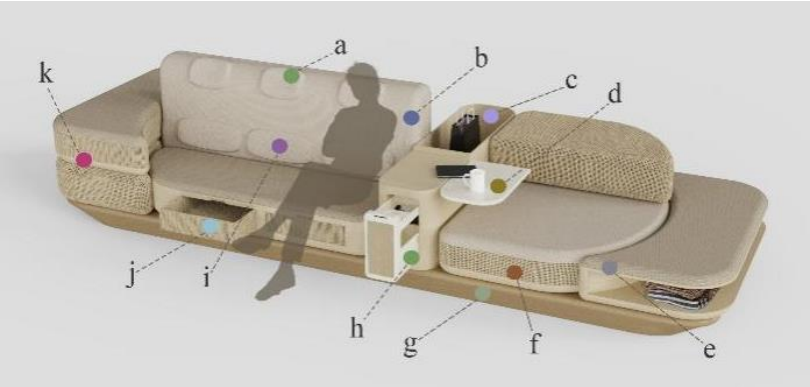

Fig. 4. Willow weaving sofa scheme drawing

DISCUSSION

To determine whether the final solution meets the consumer requirements of the Chinese market, the design team organized a 10-member evaluation team (2 furniture designers, 3 product design professors, and 5 consumers) with an age range of 30 to 50 years old. The evaluation team selected two sets of willow wood sofa products with high sales in the Chinese market (Scheme A and Scheme B) and compared them with the current design scheme (Scheme C) in the form of pictures. The team quantitatively evaluated the M, O, and A of three sets of willow sofas on a scale of 1 to 10, and the final results show that B (106.7) < A (126.7) < C (185.3). Therefore, this design scheme was found to meet the requirements of Chinese users. Figure 5 shows the user scoring statistics.

	A1	A3	A6	A10	A11	C6	A5	B1	C2	C4	C5	A4	B2	C3	Average Mark
 Scheme A	46	39	21	72	41	113	152	125	97	142	115	107	132	65	126.7
 Scheme B	86	124	59	83	31	94	23	74	46	137	65	54	122	69	106.7
 Scheme C	175	131	162	152	119	124	133	147	105	126	139	112	136	92	185.3

Fig. 5. User scoring statistics

CONCLUSIONS

1. This research focused on the specific requirements of consumers for willow sofas and explored the innovative design direction of willow sofas with user satisfaction as the core. The Kano model was used to obtain the classification of user requirements, AHP was used to quantify the weight ranking of each requirement, and TRIZ theory was used to solve the engineering problems in the design process to ensure the scientific and effectiveness of the design process. Through the comprehensive application of the Kano-AHP-TRIZ combination, the willow sofa was designed to meet the current market trends, which not only satisfies the diversified requirements of consumers, as well as provides new research perspectives and design strategies for the innovative development of the furniture industry.
2. The Kano model analysis indicated that Warmth, Harmonious proportion, Easy washing, Crude wood, Human-machine engineering, Modern style, Security, Head support, Modularization, Storage, Desk board, Easy installation, Lumbar support, and Composite material were the primary requirements of the user for willow furniture, clarifying the focus of the subsequent design. The AHP method was used to rank user requirement weights to improve the accuracy of user requirement assessment during the design process. In the criterion hierarchy: Storage> Composite Material> Lumbar Support > Modularization > Head Support > Desk Board. The object hierarchy was ranked as follows: Drawer Storage Space > Willow and Fabric > Fixed Lumbar support> Combination > Open Storage Space > Fixed Head Support > Willow and Other Wood > Pillowcase > Folding Desk Board > Stack > Cabinet Storage Space> Willow and Leather>Pillowcase > Rotating Desk Board > Adjustable Lumbar Support > Shared Component > Willow and Metal > Interchangeable Component > Elevating Head Support > Fixed Desk Board.
3. The TRIZ theory was introduced to resolve the contradictions in user requirements. The physical contradiction between drawer storage space and open storage space was resolved using No. 1 (Segmentation) and No. 3 (Local conditions). The physical contradiction of the fixed lumbar support pillowcase was addressed through combination No. 5 (Consolidation), No. 6 (Universality), and No. 33 (Homogeneity). The technical contradiction between easy installation and drawer storage space was solved by applying No. 26 (Copying). The technical contradiction of easy-washing composite material was addressed through No. 26 (Copying) and No. 17 (Shift to a new dimension). The final design development was thus completed.
4. In order to verify the scientific validity of the evaluation system, the design scheme was compared and evaluated with the two most popular willow sofas in the Chinese market. The design schemes were ranked as follows: scheme C (185.5) > scheme A (126.7) > scheme B (106.7). These findings demonstrate the superiority of this design over other similar products. However, due to the limited number of samples in this research, the results will still be affected by subjective factors. In the future, the authors plan to expand the scope of sample collection and obtain more data to make the research results more comprehensive, so as to further improve the design research of willow furniture.

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