

Design Strategies of Bamboo Products Based on Prototypes of Regional Cultural Objects

Ruijing Cao¹ Tao Xie² Ying Liu³

^{1,2,3} Academy of Fine Arts, Huanggang Normal University, Huanggang, Hubei 438000, China

² Corresponding author. Email: xietao@hgnu.edu.cn

ABSTRACT

Folk bamboo utensils and bamboo making techniques are important components of traditional Chinese handicrafts, and are exemplary handicrafts with national and regional cultural characteristics, whose craftsmanship ideas and design values have enlightening effects on modern design. To address the lack of innovation in the stylized design of modern bamboo products, this article proposes a method and path to integrate prototype theory into the creative design practice of bamboo products. It takes traditional bamboo utensils as a case study for the prototype design and analysis of regional cultural objects, constructs an analytical framework for regional cultural object prototypes, and proposes a design transformation application model for regional cultural object prototypes. Combining the project design practice of bamboo products, the practicality and effectiveness of the analytical theory of object prototype design have been further verified, providing a reference for the modernization transformation and application of traditional processes. Introducing prototype theory into the modern bamboo product design and development system helps to enhance the cultural connotation of the product, form differentiated product style features, expand the shape and functional value of the product structure, meet the emotional and differentiated consumption needs of users, and reshape the contemporary value of traditional bamboo utensils.

Keywords: Regional culture, Object prototype, Design prototype, Form translation, Bamboo product design.

1. INTRODUCTION

The Chinese nation has a long history of knowing about and utilizing bamboo, spanning over 7,000 years. China is also the earliest country to create a bamboo civilization, and the bamboo production process can be traced back to five thousand years ago.[1] The development of traditional Chinese bamboo utensils has a solid material foundation, survival soil, and development environment. The shape craftsmanship of bamboo utensils contain valuable technical experience, hidden knowledge, and creative wisdom passed down from generation to generation. In the early days, bamboo utensils were mostly used for daily household life, and to this day, there are still many bamboo household products in modern life. These bamboo utensils, which are closely related to people's livelihood and daily use, have not only derived numerous types and categories of utensils during the thousands of years of inheritance and

development, but also formed a complete creation concept and design system. Under the trend of advocating high-quality development of traditional craftsmanship, the transformation and innovation of traditional bamboo utensils and its shape craftsmanship in the context of modern design is not only a response to the inheritance and innovative development of traditional craftsmanship, but also a positive measure to further improve and enrich the home product design system.

2. CULTURAL OVERVIEW OF TRADITIONAL FOLK BAMBOO UTENSILS IN SOUTHEASTERN HUBEI

Hubei has a long history of hacking bamboo to make utensils with a wide range of fields since ancient times. In modern times, the traditional folk bamboo utensils in the southeastern region of Hubei

are the most famous, and the bamboo making techniques there are the most exquisite. During this period, there are more than ten bamboo utensils and techniques named by region, and there are over a hundred types of bamboo utensils and bamboo products. Over the past century, the types and varieties of folk bamboo utensils in southeastern Hubei have continuously developed and gathered, forming a bamboo utensil cultural system with strong Jingchu characteristics.

2.1 The Evolution of Folk Bamboo Utensils in Southeastern Hubei

The southeastern region of Hubei, China, is bordered by northern Jiangxi to the east and Xiaoxiang to the south, belonging to the transitional zone from the Jiangnan Plain to the Jiangnan Hills. The terrain and environmental climate there are particularly suitable for bamboo cultivation and growth, providing abundant raw materials for the production of bamboo utensils. Historical archaeology has found that as early as the Spring and Autumn and Warring States periods, the production of bamboo utensils in the State of Chu demonstrated a high level of craftsmanship and aesthetic value, with distinct artistic characteristics and practical aesthetics.[2] Moreover, as a migration corridor, southeastern Hubei has had multiple immigrants since the Song Dynasty. The migration, mutual infiltration, and evolution of regional cultures have formed a diversified feature of bamboo utensils in southeastern Hubei integrating north and south, and incorporating things of diverse nature. Until modern times, Xianning, Chibi, and Wuxue have been known as the "Hometown of Nanzhu", "Hometown of Chinese Bamboo", and "Hometown of Bamboo Art" due to their famous bamboo production and bamboo making. There are currently more than ten provincial-level intangible cultural heritage projects, including "Xian'an Bamboo Carving, Tongshan Bamboo Carving, Wuxue Zhang Shuiquan Bamboo Carving, and Xinzhou Bamboo Carving", as well as more than ten local intangible cultural heritage projects such as bamboo weaving and bamboo carving.

The application of folk bamboo utensils is relatively extensive, involving many aspects such as life, production, and culture. Traditional bamboo utensils in southeastern Hubei can be roughly classified into three categories based on their functions and forms. The first category is bamboo utensils used in daily life, such as bamboo furniture,

bamboo utensils used for cooking and drinking, daily necessities, etc. The second category is agricultural bamboo utensils used for labor production, such as utensils for storage, farming tools of rice, fishing bamboo utensils, and fishing bamboo rafts and so on. The third category is entertainment bamboo handicrafts, such as various forms of bamboo carving, sculpture, weaving and other bamboo handicraft products, as well as bamboo incense tubes, bamboo pen holders, arm resting pillows and other bamboo utensils for study. These bamboo utensils with various uses and shapes have left a deep impression on the daily life, social life, and spiritual activities of the villagers.

2.2 Contemporary Value of Folk Bamboo Utensils in Southeastern Hubei

As a handicraft for the production of objects, bamboo utensils are also a carrier of craftsman knowledge, experience, intellectual wisdom, and creation concepts, with typical local cultural inheritance value. The shape characteristics and connotations of traditional bamboo utensils in southeastern Hubei not only reflect the regional diversity of agricultural culture, but also reveal the spiritual connotations of Jingchu culture. Behind the perceptible material forms are the values, ideologies, spiritual levels, and local customs and beliefs contained. The production process of traditional bamboo utensils is a process in which bamboo craftsmen present their ingenious ideas through material forms, encompassing both material production and artistic creation, with the characteristics of manifestation and proof of object creation. From the perspective of value, folk bamboo utensils in southeastern Hubei have cultural, artistic, technological, economic, and industrial value.

3. THE DESIGN TRANSFORMATION VALUE OF TRADITIONAL BAMBOO UTENSIL CULTURAL OBJECT PROTOTYPES

Thousands of years ago, people had already realized the natural characteristics of bamboo of being hollow, flexible, and plastic, and applied it to the production of daily utensils after processing the original bamboo form. From the development of the agricultural era to the present, the shape of bamboo utensils has undergone an evolution from functional practicality to artistic aesthetics, and has also formed a systematic system of creation techniques. Under the concept of "low-carbon" and

sustainable development, the transformation value of traditional bamboo making technology has also begun to receive attention in the design field. The use, efficiency, and standardized development of innovative bamboo products in various industries have created conditions for the utilization of new technologies and the development of new products using bamboo instead of plastic. The value transformation of traditional bamboo making techniques in the modern home product design system not only helps to enhance the added value of bamboo products, but also reduces the decay of craftsmanship in modern life. From the perspective of the interrelationship between bamboo culture, creation concepts, and shape technology, the contemporary value of traditional bamboo making design transformation is mainly manifested in three aspects.

3.1 Cultural Value of Creation Concepts and Design Ideas

Folk bamboo utensils are mostly daily necessities and agricultural tools, emphasizing the practicality of "using things for their own purposes" in terms of function. Simple as a bamboo crate or dustpan, it has its own system of standard processes and design specifications from material selection, cutting stock, cutting bamboo to weaving the shape. Based on past experience as a guide, bamboo strips are often used in areas prone to wear and tear. The control of the weaving gap of bamboo strips should consider their water repellency, breathability, and firmness. These local knowledge and tacit knowledge about bamboo making skills imply craftsmen's profound understanding of craftsmanship and technology, form and function. The practice of "making the most of everything" in craft creation is a metaphor for the life philosophy of the Chinese ancestors. From the perspective of cultural value, the design ideas and production ideas of bamboo utensils are not only ecological wisdom, but also the attitude and concept of creation in accordance with the laws of nature. This ecological design concept, which is rich in ethnic characteristics and cultural attributes, also has profound inspiration for today's product design process practice.

3.2 Application Value of Production Technology and Design Methods

As a traditional handicraft technique, the production of bamboo utensils, from a technical design perspective, is basically in line with the

standardization emphasized in modern product design. For example, bamboo weaving utensils are formed by inserting, teasing, and pressing bamboo strips and bamboo filaments, and the weaving technique is rigorous, just like a parameterized design system. Bamboo furniture is made by processing bamboo segments with fire bending, openings making, drilling, and tenoning, and then assembling bamboo components into shape through joggling, embedding, entanglement, and pin fixation. In this way, stability and firmness are achieved through the mechanical properties and structural insertion and restraint of bamboo materials. The scale design, shape process, technical indicators, and scientific norms reflected in traditional bamboo craftsmanship make it possible for traditional craftsmanship to connect with modern design.

3.3 Ecological Value of Materials and Process Characteristics

The raw bamboo materials used in traditional bamboo utensil production can be roughly divided into three layers: bamboo outer skin, bamboo texture, and bamboo inner skin, with each layer having its own unique color, character, and texture. In terms of materials and craftsmanship of bamboo utensils, bamboo weaving is taken from the surface of bamboo material, and furniture is made of bamboo tubes as a whole. Liuqing bamboo carving and carved bamboo ware are mostly suitable for surface decoration of utensils, and the root to the tip of bamboo are fully and reasonably utilized. In traditional bamboo making techniques, bamboo craftsmen usually use the form characteristics and physical properties of bamboo itself to assemble components by mortising and fixing bamboo pins, achieving load-bearing, bending, and shaping in the structural design of objects, ensuring consistency and ecology in material selection. Whether in terms of material aspects of craftsmanship and production technology, or in terms of artistic expression and aesthetic spirit, the natural characteristics, aesthetic quality, and ecological value of raw bamboo materials have been well reflected.

4. ANALYSIS METHOD AND DESIGN TRANSFORMATION MECHANISM OF TRADITIONAL BAMBOO UTENSIL CULTURAL OBJECT PROTOTYPES

The prototype research in the field of design mainly refers to two aspects: Firstly, prototypes in the field of design are general and typical. Secondly, the prototype in the field of design is unconscious. The former emphasizes that prototypes are typical as well as their characteristic attributes within a category, while the latter emphasizes that prototypes are the deep psychological structure and source of inspiration for designers.[3] From these two dimensions, traditional bamboo utensils, as a cultural object prototype, refer to the original form, initial style, and typical characteristics of the objects they possess. On the other hand, it points out more from a cultural perspective that traditional bamboo utensils are a social and cultural prototype with collective creative properties that can be inherited.

The design transformation mechanism and process driven by object prototypes are as follows: Firstly, the feature information of the object prototype is extracted and classified, mainly analyzing the appearance, color, and texture of the object shape comprehensively. The feature elements are extracted separately, and relevant factors such as cultural customs, production and operation, and production technology are comprehensively considered in the context of the

object prototype. Secondly, after formally reproducing and refining the prototype, key prototype features are determined through joint analysis to guide the design and development of creative products. It will design and restructure the prototype features obtained from analysis, and optimize and adjust them until an idealized product instance solution is obtained. Then, under the guidance of industry experts, the design plan is evaluated in terms of cultural attributes, form structure, market feasibility, and other aspects to continuously improve and improve the design plan.

The design analysis of regional cultural object prototypes can provide theoretical support and factual basis for digital representation and design creativity of object prototypes. Starting from the two theoretical systems of objects and prototypes to analyze regional cultural objects and their prototypes, propose basic application paradigms of regional cultural object prototypes, and explore specific digital methods and technological foundations is conducive to exploring the implicit concept and laws of creative design in traditional utensils, as well as expanding and continuing the modern design of regional cultural heritage.[4] Based on the implementation process of bamboo product design and development, the design analysis and transformation of traditional bamboo utensil cultural object prototypes can be roughly divided into five steps: selection, analysis, extraction, transformation, and application. The content framework and technical roadmap are shown in "Figure 1".

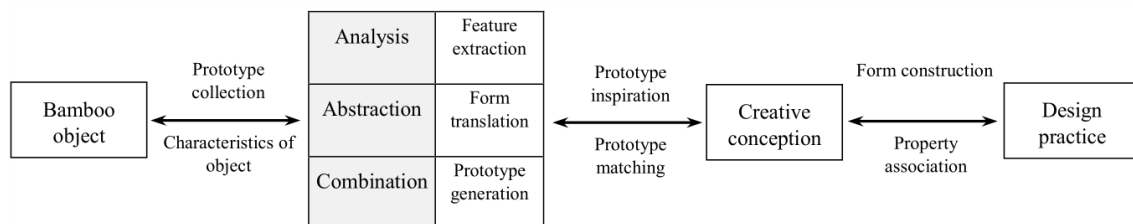


Figure 1 Prototype analysis of traditional bamboo objects and innovative design model of bamboo products. (Source: self-made)

The creative design application mechanism model based on cultural object prototypes can enable designers to accurately grasp the cultural core, fully explore the connotation and extension of cultural elements, and accurately connect and fully align the designed products and services with modern social life and consumer needs, enhancing added value and industrial competitiveness.[5]

5. THE APPLICATION OF PROTOTYPE ANALYSIS AND TRANSFORMATION OF REGIONAL CULTURAL OBJECTS IN THE DESIGN OF BAMBOO CULTURAL AND CREATIVE PRODUCTS

The design analysis and transformation framework of prototypes for regional cultural heritage objects aims to absorb fundamental research results from cultural objects, thereby expanding and continuing the modern design and development of regional cultural heritage. To verify the effectiveness of the prototype analysis and transformation model of regional cultural objects applied to bamboo product design, this study selects bamboo utensils collected by the "Dabie Mountain Agricultural Culture Museum" as the material for practical research, further clarifying the feasibility of the design scheme.

5.1 Overview of Prototype Driven Bamboo Cultural and Creative Product Design Project

The "Dabie Mountain Agricultural Culture Museum" is located on the campus of Huanggang Normal University in Huanggang City, Hubei Province, China. It is a base for the inheritance and research of regional folk culture, showcasing the material cultural heritage of production, living customs, and folk art from various dynasties in the Dabie Mountain region of China. The museum collects some bamboo agricultural production and living utensils with regional cultural characteristics. These bamboo utensils have distinct craftsmanship and form characteristics, and can be used as typical cultural object prototypes for the design and development of modern bamboo cultural and creative products.

Although most folk bamboo utensils are common utensils used for people's livelihoods, each utensil contains many connotations that are closely related to the social system, technological culture, technological ethics, lifestyle and production methods of the past, and is a typical prototype of regional cultural object. This study takes the traditional bamboo utensils in southeastern Hubei as the prototype of regional cultural objects. Through the study of things and objects, it explores their specific object structure, shape characteristics, process characteristics and design value, and finally forms design thinking models and experience that

can be applied to the development of bamboo cultural and creative products.

5.2 Selection and Design Analysis of Typical Bamboo Utensil Prototypes

Through comparison and selection, a representative traditional bamboo utensil "fish cover" ("Figure 2") and another characteristic bamboo utensil "bamboo woven gourd" ("Figure 3") in the "Dabie Mountain Agricultural Culture Museum" from southeastern Hubei are selected as practical cases for analyzing the prototype design. The "fish cover" is a bamboo utensil used for fishing, made of fine bamboo strips and woven into a conical cylindrical shape, with small top and large bottom, and no top or base. "Bamboo woven gourd" is a bamboo woven container with gourd as the inner core, used to hold tea and other beverages. The outside of the pot is woven into a basket cover with fine bamboo splits, and the inside is a naturally grown gourd.



Figure 2 Bamboo fishing gear "fish cover". (Image source: Dabie Mountain Agricultural Culture Museum, taken by the authors)



Figure 3 Bamboo container "bamboo woven gourd". (Image source: Dabie Mountain Agricultural Culture Museum, taken by the authors)

After completing the information collection of the bamboo utensil prototypes, it then analyzes the relevant elements that can be used as creative design activities. The material prototype of bamboo utensils can be extracted into formal features

described by graphics, while the cultural prototype can be extracted into semantic features described by language and text, mainly analyzed from the shape, structure, pattern, color, function, and usage of the utensils (such as "Table 1").

Table 1. Analysis of prototype design of traditional bamboo utensil cultural objects

Prototype	Analysis of the prototype element design					
	Shape	Structure	Pattern	Color	Function	Usage
Fish cover	A conical cylindrical shape Being open up and down	Bamboo weaving Being closed up and down	Orderly emit	Bamboo natural color	Fishing, fishing gear	Buckle cover
Bamboo woven gourd	Spherical combination, Being big up and down small	Bamboo weaving, From the bottom being closed	Misorderly intertwine	Blue, bamboo natural color	Containing liquids	Hold, hangable

After correlating the prototype element analysis results of fish cover and bamboo woven gourd with the design characteristics of common household products, the modeling features that can be applied to creative design include shape, structure, pattern, color, and function. Among them, the main source of visual representation and creative design activities is the appearance molding of the utensils. In design practice, the shape, color, pattern, and connotation of bamboo utensil prototypes are extracted, abstracted, summarized, and formalized, visualized, and patterned to meet the needs of design creativity.

5.3 Cultural Element Transformation and Design Concept Generation

In the process of cultural and creative design, prototype theory mainly drives design through "prototype inspiration" and "prototype matching". Prototype inspiration "refers to the solution of creative problems by cultural prototypes, which stimulates the generation of design inspiration. "Prototype matching" refers to the analysis of prototype matching to ensure the correctness of creative ideas and facilitate the improvement of creativity.[6]

In the design analysis and transformation of fish cover and bamboo woven gourd as object prototypes, the design process mainly includes three basic steps. Firstly, in the conceptual stage, representative bamboo utensil objects are selected

as prototype samples and form prototype features are extracted. Secondly, using prototype form features as key inspiration information, it carries out creative design and visual visualization of the target product's shape. Finally, design verification is carried out by selecting appropriate materials and processing techniques, rendering the digital model in the scene to obtain the design effect pattern, or using 3D printing and other technologies to achieve physical product design samples.

5.4 Implementation Process of Bamboo Cultural and Creative Product Design

In the design and implementation stage of bamboo creative products, based on the analysis conclusions of the prototype design in the early stage, the feature information of the prototype is used to inspire the creativity of product design. It selects lamps with more matching shape correlations as the product design goal, and uses techniques such as abstraction, deformation, induction, and combination to reconstruct product creativity. It mainly uses the form and structure of prototypes as creative reference sources to construct a three-dimensional model of the design scheme, continuously refining and evaluating the form structure, cultural attributes, aesthetic appearance, functional value, and scalability of the lamp product model. Based on the evaluation results, the lamp product model is optimized and improved. The final model scheme is shown in

"Figure 4", "Figure 5", "Figure 6", and "Figure 7"
(designers: Zhao Wenrui, Xie Tao).



Figure 4 "Bamboo shadow" ceiling lamp design scheme 1. (Designers: Zhao Wenrui, Xie Tao)



Figure 5 "Bamboo shadow" ceiling lamp design scheme 2. (Designers: Zhao Wenrui, Xie Tao)



Figure 6 "Fun of bamboo" table lamp design scheme 1. (Designers: Zhao Wenrui, Xie Tao)



Figure 7 "Fun of bamboo" table lamp design scheme 2. (Designers: Zhao Wenrui, Xie Tao)

6. CONCLUSION

Cultural and creative design is an effective way to inherit and innovate regional cultural resources. Studying the original appearance of regional cultural objects from a design perspective, and conducting cultural translation and design transformation to develop cultural and creative products that meet contemporary consumer needs can guide users to enhance their understanding of regional culture. The design and analysis of regional cultural object prototypes can achieve the sorting and analysis of cultural elements. Prototype driven creative design practices can realize the translation and design regeneration of cultural resources.

This project takes the agricultural bamboo utensils collected in the "Dabie Mountain Agricultural Culture Museum" as an application case to carry out cultural and creative product design and development practice. By analyzing the cultural object prototypes of bamboo utensils, typical features of the utensils are obtained as key information, inspiring creative thinking in design and guiding design practice. The design process is mainly divided into three stages: the analysis of traditional bamboo utensil cultural object prototypes, the generation of design creative thinking, and the development and design of creative products. The final completion of the "bamboo woven ceiling lamp" and "bamboo woven table lamp" series of home products confirms the effectiveness and application value of the design mode of object prototype design analysis and prototype driving, which has certain reference significance for modern cultural and creative

product design innovation. However, due to the limited number of validation models in project design practice, it is still necessary to find more widely applicable indicators in practical applications. The design implementation and scheme output also need to be further clarified to further improve and optimize the design methods and modes.

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