

A Study on Constructing Digital Resource Sharing and Management Platform by Applying Cultural Compositions of the Historical Urban Area

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Abstract

With the characteristics on recording the trace of human life, cultural heritage is acknowledged as possessing significant humanistic, spiritual, and socio-economic values. However, there remain problems such as insufficient integration with science and technology, inadequate design innovation, and the lack of digital construction. Based on these problems, the article discusses the need of constructing a digital management platform with cultural heritage knowledge, the expression paradigm, the essential contents, and key technologies. By elaborating current status of its application and utilization, the study explores issues including scattered resources, simple transplantation and lacking digital approach. And it found that designers' cognition on cultural heritage is relatively superficial, especially for images and literal meanings. Aiming for sharing design knowledge of cultural heritage, the study proposes a conceptual model digital platform of management based on the exploration of design process in extracting cultural elements and verifying the feasibility where design needs can be achievable. Taking Macao's historic area as an example, the study demonstrates a way to construct the digital resource sharing and management platform using "open source" approach as a sort of design alternative where cultural elements and compositions can be applied efficiently.

Keywords: Cultural heritage, Design management, Digital platform, Open source, Macao's historic center

1 Introduction

Under the trend of globalization, countries and regional cultures are striving for promoting significant growth in national GDP and regional economies through the redevelopment and re-creation of local cultural resources. China's rich historical and cultural heritage provides a solid foundation for cultural creative design and industries. At the same time, cultural technology has shown vigor in the process of cultural innovation, and information resources provide a diverse platform for integrating and applying cultural resources [1]. However, many cultural heritage resources in China lack connotation mining and knowledge

management from the perspective of creative designers and leave problems on insufficient correlation between cultural heritage knowledge. And these are mainly manifested in:

(1) Chinese art and design education has been based on Western design theoretical systems and specific teaching methods and requires research on the integration of traditional culture into art and design courses for learning [2]. Consequently, it is in need to integrate cultural elements into the curriculum and design process training, propose a model for the integration of culture into the design process, cultivate designers' local cultural awareness and, construct design theories and methods according to China's national conditions.

(2) The existing repositories of cultural heritage-related resources are not constructed specifically for designers' needs and fail to fully consider the convenience and effectiveness of designers while creating. For example, Huaping Gong et al. integrated and classified cultural heritage information into 6 models Gong 45 major categories [3]; Meyer et al. established a cultural heritage information management system [4]; researchers from the Capital Museum introduced knowledge mapping into cultural heritage resources [5]; Weiping Zhu et al. established a cultural heritage information management system in Zhejiang Province [6]. These cultural heritage resources are abundant but cannot efficiently support designers' creative design applications. Hence, there is a need to analyze the cultural elements and design goals required by designers, and again build a designer-oriented knowledge management platform based on which visual browsing and rapid retrieval of knowledge can be achieved, truly providing strong support for creative design activities.

2 Methodology

(1) Exploring experiments: the impact of cultural inspiration on innovative design

An exploratory coordinated experiment to observe how designers analyzed the cultural heritage resources (e.g., images, videos, texts, etc.) during the pre-design phase? What kind of cultural elements are extracted by designers? How do they translate these cultural elements into design outcomes?

(2) A design model for the composition of cultural heritage knowledge

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Through the case study and comparative analysis methods, and the design process, the design requirements are decomposed into visual level, behavioral level, and emotional level. Then matching them with cultural elements and the topological transformation rule is placed in the process to build up a cultural composition design model and verify the feasibility through examples.

(3) Digital design platform of management for cultural heritage knowledge

Based on the above results, a digital design platform with presentation, management, and resources sharing related to cultural heritage knowledge will be established.

3 The Influence of Cultural Inspiration on Creative Design

Inspiration can awaken creativity and can also serve as an anchor point for solving current dilemmas. According to previous studies [7-8], designers searching for inspiration are more frequently and consistently inspired to influence the design process if they are stimulated by a large number of references, with the end result being very similar to the subconscious stimuli. Therefore, an exploratory experiment was initiated to explore the influence of cultural inspiration on the creative design process, for example, what types of references designers prefer, how they analyze cultural references, what cultural elements they extract and what specific influences they have.

3.1 Introduction to the Experiment

The cultural sample of this experiment is divided into two common types, namely visually stimulated cultural

inspiration, and textually stimulated cultural inspiration. A total of 16 designers participated, 13 of them were female and 3 male, with an average age of 20 years old. The subjects were all from the third year of the design program at the Macau Polytechnic University, and they had already received basic training in design theory and design methodology. They have received basic training in design theory and methodology, and they are able to understand the knowledge of visual composition of cultural heritage and its specific application in different fields. Therefore, the subjects met the objectives of this experiment. The main purpose of the experiment is to understand the composition and application of cultural elements. Images and textual materials collected for this experiment were sourced from UNESCO's official website and published books, and were rigorously selected by the study to identify three image samples (visually stimulated cultural inspiration) and text samples (textually stimulated culturally inspired), and using sketch56.2 in which the picture samples were output to the same specification.

The 16 participants of the experiment were divided into 2 groups, the culturally inspired group with visual stimuli (CIV) and the culturally inspired group with visual plus paper stimuli (CIVCIT), with 8 participants in each group. Each group was provided with 1 sheet of 3A paper, pencils and black water pens, and no erasers or coloured drawing materials for the purpose of collecting the most original design process and design sketches, and the experimental process required participants to work independently.

3.2 Experimental Tasks

The experimental procedure was divided into three parts and the process lasted approximately 60 minutes, as follows (Figure 1).

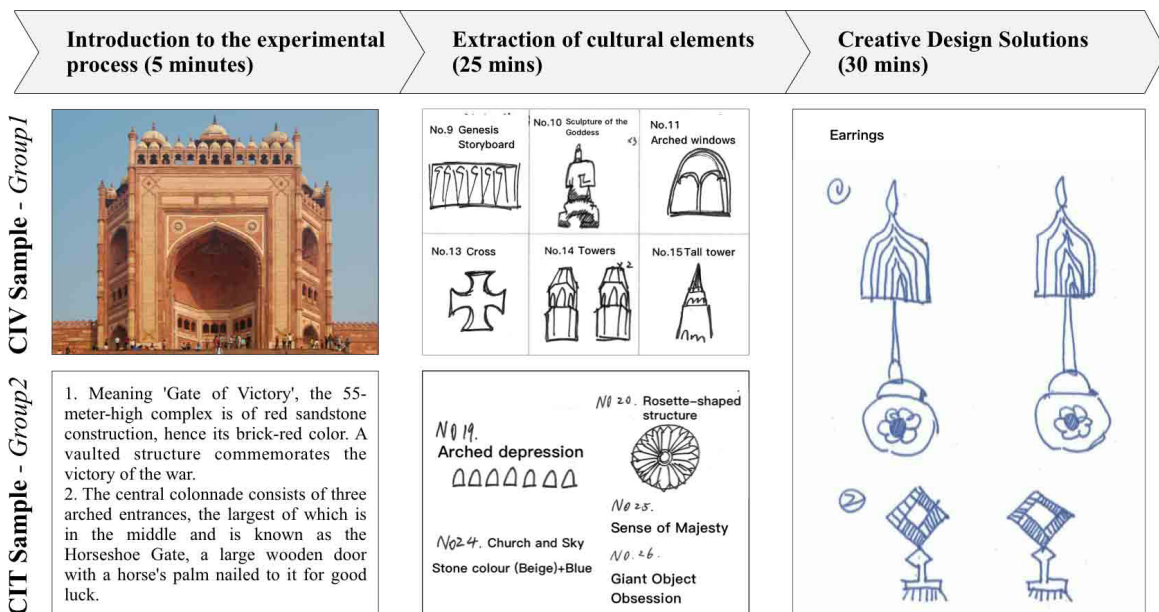


Figure 1. Experimental procedures and specific information

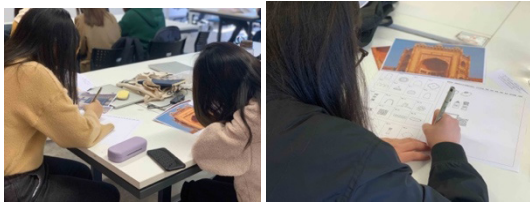


Figure 2. Subjects are observing cultural inspiration and design work

Introduction: Presentation of the experimental process to participants about the experiment, lasting 5 minutes.

Task 1: Extraction of cultural elements. This stage requires participants to observe or read the information carefully and extract as many cultural elements as possible. There is no limit to the form of the extracted presentation, keywords, phrases, sketches, etc. This stage lasts approximately 25 minutes.











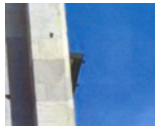







Task 2: Translate the extracted cultural elements as a design solution. This stage requires participants to transform the extracted cultural elements from Task 1 into a design solution, regardless of the type of design, such as packaging design, poster design, product design, etc. This stage lasts approximately 30 minutes.





A photographic record of the phase in which the participant is extracting cultural elements is shown in Figure 2.

3.3 Experimental Results

A total of 16 valid experimental results were collected for this experiment, with no gaps or invalid documents. The study counted the types of cultural elements extracted from each test group, yielding 11 types. These cultural elements were classified into visual-level cultural elements, behavioral-level cultural elements and emotional-level cultural elements based on existing research theories, while their numbers were further counted (Table 1).

Table 1. Classification of types of extracted cultural elements

Type	Type of cultural element	Extraction of cultural elements	Extraction of cultural elements
Visual culture elements	Styling		No.1 Shape  No.15 Tall tower 
	Stereoscopic pattern		No.10 Sculpture of the Goddess  No.8 Lion 
	Graphic design		No.1 Cross fence 
	Pattern		No.4 Rose Window Muslin Decoration 
	Color		No.2 4. Church and Sky Stone colour (Beige)-Blue No.2 Color Stone, Beige, Orange
Behavioral culture elements	Materials		No.3 Material, Stone
	Structure		No.5 Pilasters  No.7 Roman Columns  No.11 Rose Window Column 
	Functional use		No.2 Recessed Hole 

	Feelings and emotions	-	No.25. Sense of Majesty
			No.26. Giant Object Obsession
Emotional cultural elements	Symbolic		No.12 Rose 
	Storyline		No.9 Genesis Storyboard 

To better counting results of the experiment, the study divided the results into CIV1, CIV2, ..., CIV8 according to the group and another group into CIVCIT1, CIVCIT2, ..., CIVCIT8. The cultural elements were then categorized in the table above and counted quantitatively (Table 2). Hypothesis 1 holds, because the CIVCIT group is supported by more textual information stimuli than the CIV group. Consequently, it will extract richer cultural elements. Furthermore, from a three-level perspective of culture, both the CIV and CIVCIT

groups extracted the most cultural elements at the visual level, followed by cultural elements at the behavioral level, and finally cultural elements at the affective level. Besides, the CIV group did not extract any cultural elements at the emotional level, while the CIVCIT group extracted six cultural elements. As a result, it can be judged that these text stimuli play a role in the extraction of cultural elements at the emotional level, which can enable designers to deepen their thinking.

Table 2. Quantitative statistics for extraction of cultural elements stage elements

Type	Type of cultural element	CIV1	CIV2	CIV3	CIV4	CIV5	CIV6	CIV7	CIV8	Total
Visual culture elements	Styling	4	5	2	7	7	3	3	3	34
	pattern	3	8	5	2	0	1	2	0	21
	Graphic	1	1	1	7	6	7	10	11	44
	Pattern	1	1	1	1	0	0	2	0	6
	Color	0	0	0	0	0	0	3	0	3
Behavioral culture elements	Materials	1	1	0	0	2	1	1	1	7
	Structure	3	1	1	0	1	1	0	0	7
	Function	0	0	0	0	0	0	0	0	0
Emotional cultural elements	Feelings and emotions	0	0	0	0	0	0	0	0	0
	Symbolic	0	0	0	0	0	0	0	0	0
	Storyline	0	0	0	0	0	0	0	0	0
Total		13	17	10	17	16	13	21	15	122

Type	Type of cultural element	CIV CIT1	CIV CIT2	CIV CIT3	CIV CIT4	CIV CIT5	CIV CIT6	CIV CIT7	CIV CIT8	Total
Visual culture elements	Styling	5	10	8	7	7	12	8	3	60
	pattern	12	6	4	1	1	0	5	2	31
	Graphic	1	1	1	7	8	5	3	3	29
	Pattern	1	1	1	1	1	1	2	1	9
	Color	0	5	0	1	1	1	1	2	11
Behavioral culture elements	Materials	1	1	1	1	1	0	1	2	8
	Structure	3	4	1	1	2	2	0	0	13
	Function	0	1	0	0	0	0	0	0	1
Emotional cultural elements	Feelings and emotions	0	2	0	0	0	0	0	0	2
	Symbolic	1	1	1	0	0	0	0	0	3
	Storyline	0	1	0	0	0	0	0	0	1
Total		24	33	17	19	21	21	20	13	168

In addition, the more cultural elements extracted the more design outcomes are transformed. As shown in Table 2, the CIV group extracted a total of 122 cultural elements and converted them into 40 design outcomes; the CIVCIT group extracted 168 cultural elements and converted them into 50 design outcomes. The paper further analyzed the types of design outcomes and found that the CIV group’s design outcomes were mainly jeweler design and product design, accounting for 82.5% of the total design outcomes, while the CIVCIT group did the same, accounting for 62%, but the participants in this group also produced in other design areas, for example, subject CIVCIT2 designed a VR piece with a “The Creation of Adam” story; CIVCIT4 designed a poster design with cultural elements in the title; CIVCIT6 has designed jeweler pieces with a regional twist; and CIVCIT8 designed a clothing design with regional characteristics (Figure 3). This is presumed to be influenced by the textual stimuli.

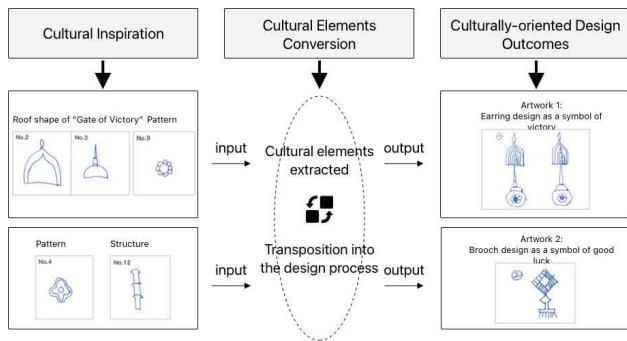


Figure 3. Design work produced by CIVCIT6 subjects during Task 2

3.4 Summary and Discussion

In summary, it is possible to identify two types of cultural inspiration based on cultural heritage, namely visually stimulating cultural inspiration, and textually stimulating cultural inspiration. They can both contribute to design innovation, with textually stimulating cultural

inspiration furthering designers’ deeper thinking in terms of emotions, symbols, storylines, etc., and helping them to create richer works in the design genre. However, textually stimulated forms of culturally inspired knowledge for designers are unclear, and cultural heritage knowledge still lacks a framework for categorizing knowledge in creative design. Consequently, it needs to integrate cultural heritage knowledge into the design process, decompose design needs and match them one by one with cultural heritage knowledge or cultural elements to meet appropriate application of cultural heritage knowledge.

4 A Design Model for the Composition of Cultural Heritage Knowledge

This section decomposes cultural heritage knowledge into visual, behavioral, and emotional level cultural elements and integrates them into the complete creative process before, during, and after design. It disassembles design requirements and applies topologic principles to the design process in proposing a new and cultural composition model composed of cultural elements and oriented towards the creative design field (Figure 4). These elements in different stages include:

- (1) Design positioning stage: Designer can communicate with the project stakeholders to determine user needs; cultural element use and design objectives.
- (2) Inspiration search stage: Based on the experimental research in the previous section, the design needs and cultural elements matching method is proposed, and designer can select cultural elements that meet design objectives.
- (3) Design concept output stage: The selected cultural elements are produced by using the rhombic thinking scalable model to evaluate the solution of design concept.
- (4) In-depth design stage: the design solution is created in depth until the final design is produced.
- (5) Outcome testing and evaluation stage: The design results are given to a selection of users for collecting comments and feedback in adjusting the design results.

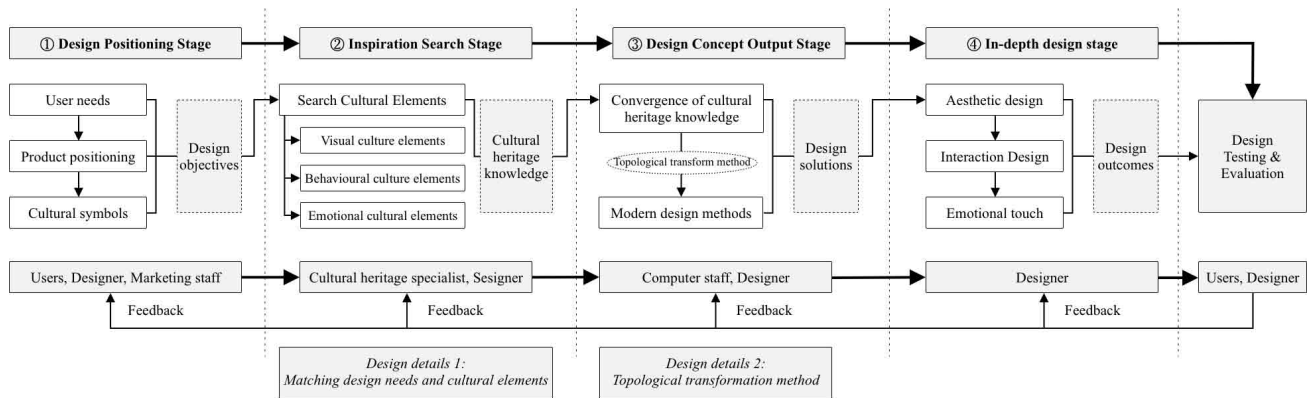


Figure 4. A design model for cultural composition based on knowledge of cultural heritage

4.1 Design Details (1): Matching Design Needs and Cultural Elements

In painting and photography, the definition of structure or organization is reckoned as composition; in graphic design, it is regarded as choreography, and in spatial design, it is called as management of position [9]. Composition serves as the basic course in the design curriculum, training students how to transform disorganized, spontaneous, and uncontrollable design inspiration into searchable ‘laws’ [10]. The cultural composition referred to the text is oriented towards the field of creative design. It is described as the use of modern design techniques reflecting cultural elements and emotional experiences on design outcomes based on designers’ understanding to visual and connotative knowledge of cultural heritage, through which the user can experience a unique characteristic of cultural heritage that distinguishes it from other design works. Modern design is knowledge-based design [11] and the core work of designers in the design process is a complex information-matching process where they need to filter, reorganize, and apply cultural elements and

the information needs for cultural heritage knowledge vary at different design stages. Through in-depth interviews, Rosihan and Aris found that creative design process and sources of inspiration have a greater impact on the cultural value of design outputs and most believe that the output of fashion designers depends on their cultural inspiration, such as the style or materials of their tangible cultural heritage [12]. Linxin Zheng went a step further and used a questionnaire to find out how often designers use information related to cultural symbols [13]. The results show that designers use cultural names, cultural meanings, overall or partial pictures and visual elements are the most. While the above has explored the specific elements of cultural inspiration, it lacks a specific design process-oriented analysis. Therefore, this paper goes a step further by decomposing the three levels of design requirements and cultural elements to match them one by one, and then further illustrates these through the example of the cultural elements of “Ruins of St. Paul’s”, the cultural heritage of the Historic Centre in Macao (Figure 5).

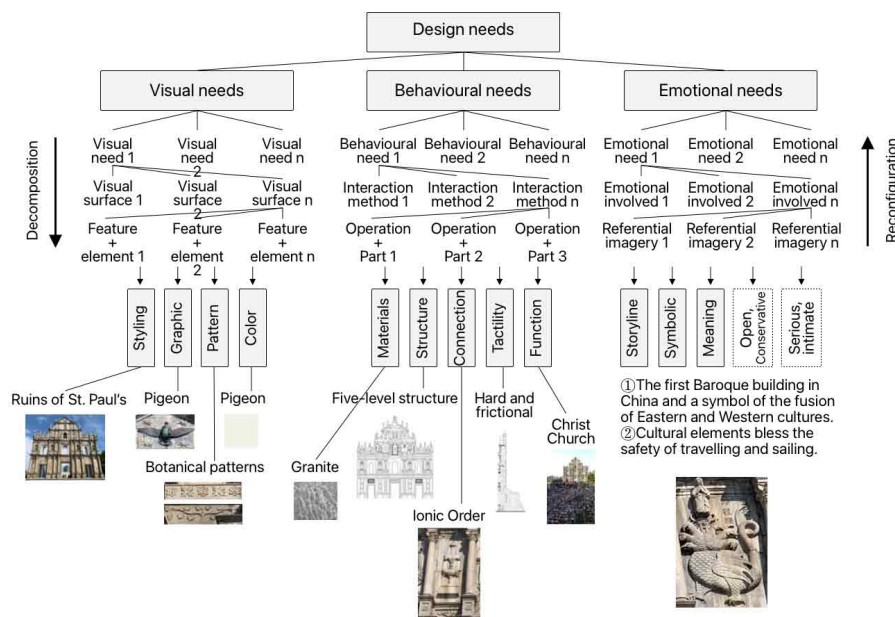


Figure 5. Process of matching design requirements and cultural elements

Design requirements can be broken into visual level, behavioral level, and emotional level. Specifically, visual level needs contain the outer and superficial visual cultural elements. They are visual needs (visual objectives to be expressed), visual surface (cultural elements contained therein) and visual expression (selection of typical visual cultural elements for restructuring). And the visual level cultural elements include shapes, patterns, motifs, colors, materials, etc.

Behavioral level requirements serve as the mid-level. It comprises operational behavioral cultural elements. They are behavioral purpose (the intended use), interaction (how the user uses it), and behavioral representation (combination of user operating habits and cultural components/structures).

And behavioral level cultural elements include structure, connections, tactility, utility, etc.

Emotional level needs are regarded as inner and psychological needs of emotional cultural elements. They are emotional needs (emotional expectations to be achieved), emotional associations (evoking emotions within the user), and emotional expressions (symbolic figurative expressions of cultural elements). And emotional level cultural elements include storytelling, special meanings, symbolism, etc.

4.2 Design Details (2): Topological Transformation Method

By combining the rhombic thinking model with topology [14-15], this approach attempts to solve the problem of

designers relying on the subjective extraction of individual cultural elements in the process of design concept exploration, and the lack of fusion and reconstruction of multiple similar types of design, and the method helps to shorten the long lead time of the design exploration phase. The theory of topological transformations refers to the formation of another unit of similar design factors by copying, replacing, rotating, adding, deleting, expanding, and clustering the design factors of the original unit (Figure 6).

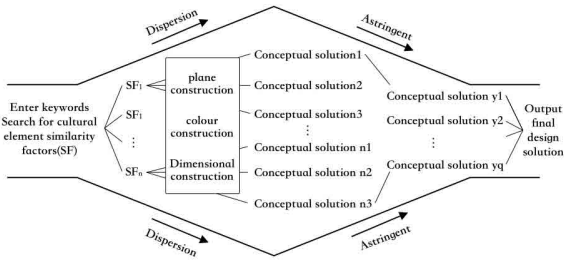







Figure 6. Integration of the topological transformation method into design concepts

4.3 Example Validation

Taking the Historic Centre of Macao as an example, the designer can enter the keyword “auspicious” into the Cultural Heritage Knowledge Design Resource Base (the establishment of which is elaborated in the next section). According to design requirements, designer can select cultural elements that meet design objectives and requirements for example, SF1, SF2, SF3, and SF4 as shown in Table 3. When the cultural elements are further disassembled into the smallest unit of cultural components as SF11, SF21, SF22, SF31, SF32, SF41, SF42, then rotating, copying, scaling and other transformations are implemented to generate SF'22, SF'31, SF'32, SF'42, and even the replacement of cultural elements, e.g. SF11+21+41; after a series of filtering and combining transformation processes on color replacement and three-dimensional composition, the final result can be regarded as a cultural and creative design with the Virgin as the centerpiece, consisting of a crown, a vase, a dove, a flower and a window pane, that meets the expectations of the ‘auspicious’ user.

Table 3. Design elements of similar cultural elements can be topologically transformed

Steps	SF ₁	SF ₂	SF ₃	SF ₄
Cultural heritage samples				
Decomposing elements	SF ₁₁ , SF ₁₂	SF ₂₁ , SF ₂₂	SF ₃₁ , SF ₃₂	SF ₄₁ , SF ₄₂
Planar composition transformation	SF ₁₁₊₂₁₊₄₁	SF' ₂₂ , SF' ₃₁	SF' ₃₂ , SF' ₄₂	
Colour composition transformation	SF' ₁₁₊₂₁₊₄₁	SF' ₂₂₊₃₁ , SF' ₃₁₊₄₁	SF' ₃₂₊₄₁	
Stereoscopic composition transformation				

5 Digital Management Platform for Designing Cultural Heritage Knowledge

The establishment of a design digital management platform oriented towards creative design, based on knowledge of cultural heritage, and managed by computer aids is an interdisciplinary field of work [16]. First of all, this platform is oriented to the field of creative designers, exploring the visual and textual cultural elements needed by designers from the experiments in Chapter 3, in order to ensure that designers can access the cultural knowledge and design resources really needed in this platform. Then, adhering to the goal of open source design thinking and open knowledge platform, the knowledge framework and cultural heritage expression for creative designers are redefined so that the cultural heritage knowledge from input to output meets the user’s needs. Finally, taking the cultural heritage knowledge of the Historic Centre of Macao as an example, a cultural heritage knowledge management platform (Knowledge Management) for operations and managers is established, including a knowledge resource base and knowledge categorization functions. As well as the design digital management platform (knowledge use) of cultural heritage knowledge for creative designers, including the functions of knowledge retrieval, design source file download, etc., which effectively assists cultural and creative design activities. The specific research contents are as follows.

- (1) Knowledge framework and expression: clarify the sources of designer-oriented cultural heritage knowledge and establish a knowledge classification framework.
- (2) Open-source design resource specifications: access to a repository of cultural element design resources, and clear definition of open, shared design document resource specifications and format requirements.
- (3) Knowledge management: cultural heritage knowledge

management, permission management and knowledge update management.



- (4) Knowledge presentation: a knowledge presentation and interaction platform for cultural heritage.

5.1 Designer-oriented Knowledge Frameworks and Representations of Cultural Heritage

Under the wave of the information technology era, the State Administration of Cultural Heritage of the People’s Republic of China [17] organized relevant research work and promulgated the “Cataloging Rules for Historical Cultural Heritage”, which standardized the information classification and index system for cultural relics of ancient cultural heritage sites, but the rules were only applicable to Chinese buildings. Meixing Liu and Fang Xu used the international standardized metadata standards Dublin Core and VRA Core metadata sets to redefine the information resource data of cultural heritage of ancient roads [18] but lacked detailed descriptions of cultural heritage site forms and specifications. In addition, Xiaodong Li has highlighted that immovable cultural heritage includes a portion of movable artefacts, and that these artefacts do not have the same value and significance if they are separated from the whole [19]. Therefore, some scholars have proposed the way of linked data to achieve openness and sharing between different data through machine readability [20]. However, they all started from the perspective of cultural heritage experts and lacked to start from the needs of designers’ design activities. Therefore, this study synthesizes the above research results, and through reading and querying a large number of cultural heritage books and design professional related materials, the classification framework of cultural heritage knowledge oriented to cultural creativity is compiled, and the knowledge is further divided into four parts, namely visual demand knowledge, behavioral demand knowledge, emotional demand knowledge and design resources, by combining the results of the experimental exploration in this paper (Table 4).

Table 4. Classification and indicator systems for cultural heritage knowledge from a designer’s perspective

Classification of cultural heritage knowledge and indicator systems		Taking ‘the holy mother tramples the head of the dragon’ as an example	
1.	Visual cultural elements	Shaping	The holy mother tramples the head of the dragon
2.		Tattoo	Dragon scale pattern
3.		Stereoscopic pattern	The Holy Mother, the Seven Heads and the Ten-Horned Monster
4.		Graphic design	-
5.		Color	Grey
6.	Behavioral cultural elements	Connection	The holy mother standing on a seven-headed pterodactyl
7.		Tactility	Rough, cold
8.		Usage	-

9.	Symbol	Brave, righteous and auspicious	
10.	Storyline	The Story of Holy Mother’s Destruction of the Dragon	
11.	Emotional cultural elements	History information	(Hishin) Sea serpent (born with many heads, which are still born after being cut off) [21]
12.		Folklore	Influenced by Chinese beliefs about Avalokiteshvara of the South Seas and A-Ma’s patronage of navigation, it was intended that the Catholic Madonna would encompass the functions of this deity [21]
13.	Related digital resources		
14.	Open design resources		

5.2 Access to Cultural Elements and Open-source Design File Specifications

Building a design resource base is a huge undertaking, so this study takes a small approach to design practice from Macau, where Eastern and Western culture were mixed. The Historic Centre of Macao includes 22 buildings and 8 square foregrounds [22]. This study collected information related to cultural heritage through internet search, field visits, books and literature, and monitored the collected image files transformed for design, using illustrator CC2018 software to extract their forms and colors, and after being reviewed by two experts in architecture and design. A total of 63 cultural element design source files were selected as the first batch of design resource library content, as shown in Figure 7.

The concept of “open source” has become an important part of the global supply chain, which refers to the open sharing of resources such as source code, design files or other creations [23]. At this stage, open platforms in the design field are beginning to emerge, led by enterprises, such as icon

font launched by Alibaba Group’s design team, icon park launched by ByteDance and other companies, and TDesign, a free open-source design resource launched by Tencent. However, in the field of cultural heritage, it is still in its “nascent” stage. Therefore, this study draws on the concept of the above-mentioned open-source platform to turn the design resource library of the Historic Centre of Macao into an open and shared design resource library, and to re-propose the index system and specification of the open-source documentation applicable to this platform, as shown in Table 5.

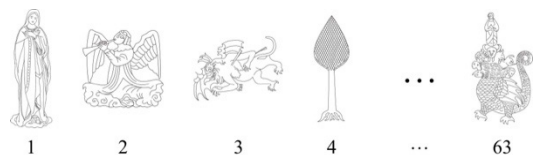
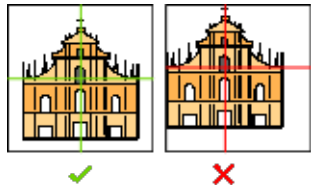


Figure 7. Extraction of cultural elements from the historic centre of Macao

Table 5. Cultural heritage design source document design code and indicator system

No.	Content	Requirements	Supplemental description	Example of drawing area
1.	Graphs	Vector graphics	Bitmap uploads are not supported	
2.	File format	.svg, .ai	-	
3.	File size	≤2.5MB	-	
4.	Mapping areas	Middle of the canvas	The guarantee is surrounded by a 10px transparent white space	
5.	Stocking time	Year-Month-Day	e.g., 2022-02-11	

5.3 Designing a Digital Management Platform for Cultural Heritage Knowledge Management

In this study, knowledge management requires the collaboration and updating of cultural heritage knowledge collectors, designers and computer administrators. Accordingly, creative design is to propose design requirements and knowledge needs. Therefore, cultural heritage knowledge collectors enter (Table 4) the corresponding cultural heritage knowledge into the management system based on the requirements and specifications, and computer administrators stipulate the data specification and operation and maintenance work. Thus, knowledge management of this platform (redesign) consists of the following four main modules, for details of the interactive interface see Figure 8.

(1) Permissions management: This is a common and important part of the platform, the purpose of which is to control the risk of permissions and manage people on the platform. The platform adopts role-based access control, and the many-to-many relationship between users, roles and permissions can support the distributed management of

administrators, which provides convenience for management of the platform.

(2) Instance Management Module: This module enables the management of cultural heritage knowledge instances. The recorded instances will be stored in the database and ontology files respectively. Each piece of cultural heritage contains four types of knowledge: visual demand, behavioral demand, emotional demand, and design resources (physical drawings and design source files). Also, it provides the instance view list sheet, which displays all the information of the instances entered.

(3) Knowledge association module: After the instances are created, the researcher can select relevant cultural heritage knowledge data for those associated and build up their derivative relationship to establish a structural hierarchy of concepts.

(4) Knowledge analysis module: By detecting and counting the number of cultural heritage knowledge and related attribute information, and visualizing them, it could enable managers to test the data comprehensively in terms of correctness, consistency, and completeness.

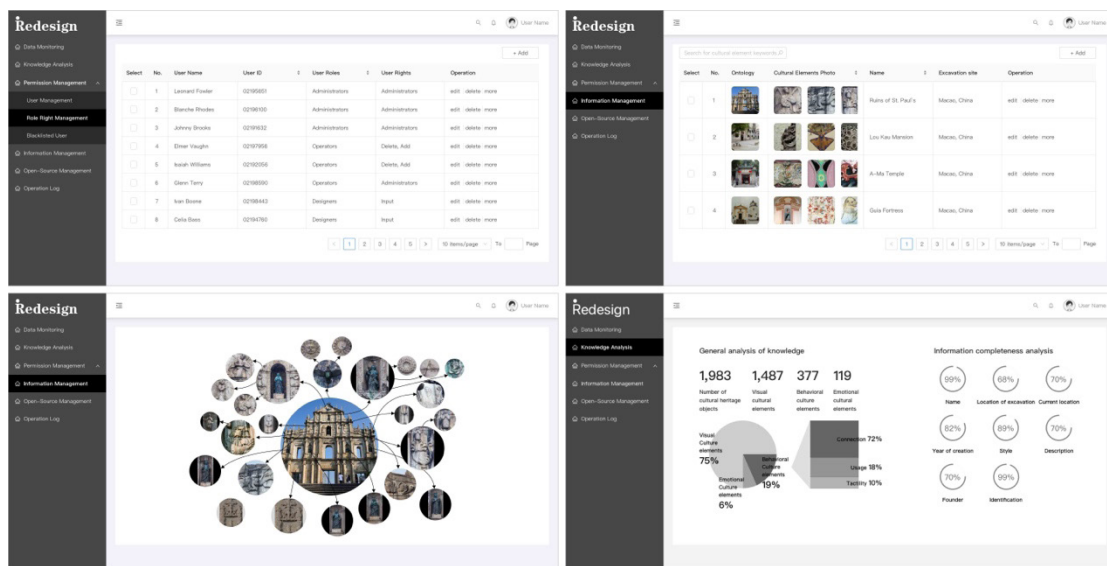


Figure 8. Designer-oriented knowledge management system interface presentation

5.4 Designing a Digital Management Platform for Cultural Heritage Knowledge Management

Based on the back-end management of cultural heritage knowledge, a front-end knowledge display platform has been developed to support the functions of displaying cultural heritage knowledge, searching and downloading design resources. This platform not only assists creative design activities, but also helps cultural heritage knowledge enthusiasts to explore the value of cultural heritage more deeply. As a design digital platform for cultural heritage knowledge and the open-source concept - "Redesign", using the Historic Centre of Macao as a resource support, it includes the following 4 modules, and the style of the user navigation interface is presented in Figure 9.

(1) Knowledge Retrieval Module: By searching the

name, concept keywords and attributes of cultural heritage, the system automatically presents the visual level knowledge, behavioral level knowledge and emotional level knowledge of the relevant cultural heritage, thus it could solve the problem of the large amount of information and relative confusion of cultural heritage knowledge.

(2) Knowledge classification display module: Information classification is an efficient form of filtering, and by setting filtering criteria, such as the "color" attribute at the visual needs level or the "meaning" attribute at the emotional needs level, the system will automatically present the filtered cultural heritage examples.

(3) Knowledge Detail Module: When an example is selected, the knowledge of the cultural heritage example is fully accessible, including visual needs level knowledge, such

as shape, pattern, color; behavioral needs level knowledge, such as structure, joints, material; and emotional needs level knowledge, such as story, history, moral, etc.

(4) My Resource Management Module: This platform encourages open-source design, so there will be a large number of designer-based users uploading and sharing design

resources, from the content contains collection of knowledge examples, design resources, uploaded design resources, etc. Users can update and delete the content in their own authorized folders at any time.

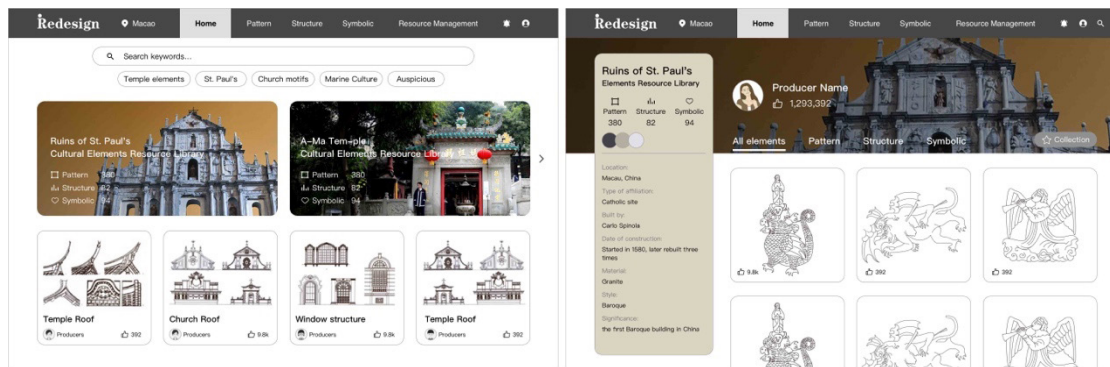


Figure 9. Cultural heritage knowledge display platform

6 Conclusion

To address the problems with insufficient integration of cultural heritage knowledge and creative design activities, inadequate mining of cultural heritage knowledge and scattered resources, through an exploratory experiment, this paper taps into the demand for cultural heritage knowledge in creative design activities. It further decomposes design demand to match with cultural elements, proposes a conceptual design model composed of cultural heritage knowledge, and reintegrates and proposes an index system for the framework and expression of cultural heritage knowledge. Accordingly, a digital platform of management for design based on cultural heritage knowledge is developed. The platform is divided into knowledge management and knowledge presentation. It is derived from the concept of “open source” design, which can effectively assist designers to access cultural heritage resources and promote the dissemination and development of cultural heritage knowledge in the field of creative design. In this way, this sharing oriented digital platform for resource management can not only provide designers with the ability to effectively add appropriate cultural elements to their designs, so that the design results can better reflect local cultural characteristics.

Based on these, the paper suggests following aspects to be covered for future research on extended topics, such as how to improve the level of automation in the construction of cultural heritage knowledge database, data association, data analysis and reasoning. In addition, how to ensure the accuracy and comprehensiveness of the content of knowledge management system would be crucial for later development too. Moreover, to build the expression specifications for designers' preferences, knowledge pushing according to differentiated characteristics, and the utilization of cultural

heritage knowledge and so on are areas that need to explore and discuss in-depth.

As the protection and inheritance of cultural heritage is at a critical stage, designers can integrate and share a large number of resources through technology to demonstrate the design achievements more effectively with local cultural elements. This study puts forward the construction of digital management platform by interpreting the cultural composition. Taking cultural heritage as the test object, it gives designers examples of how to design and produce design results of cultural elements and propose alternative design reference paths. Eventually, with the constant refinement on the conceptual frame and practice of this digital platform of design resource management, the function of cultural preservation leading to sustainable development can be better performed and benefit the protection and inheritance of cultural heritage.

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