

Cultural Derivatives of Exhibition Materials from the Perspective of Information Flow Design Innovation Research

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Abstract. Art exhibitions are for promoting social aesthetic education. As the information carrier of exhibition culture, exhibition materials play a role in the dissemination of aesthetic education between the tangible and the intangible. Based on the long-life design philosophy, the textual research continued the exhibition's lifecycle through innovative creative design after the exhibition. Reconstructing the design symbols of cultural derivatives guided the development of cultural derivative design experiments with PVC inkjet cloth as the object. The evolution from "waste product" to "product" and then to "commodity" was completed, which opened up an innovative path for exhibition culture to further enhance social aesthetic education, while also broadening the opportunities for researchers engaged in long-life design and green design.

Keywords. information flow, cultural derivative design, material recycling, PVC printing cloth

1. Introduction

China initiates thousands of offline art exhibitions by independent art colleges and universities, art institutes and departments of comprehensive colleges and universities, art-related departments of enterprises, art galleries, and museums, that are representative in the professional field every year. While producing aesthetic education effects on society, it is also accompanied by social pain points, which mainly point to two aspects. The first aspect is the tailing and pollution of exhibition materials that inherently carry the information of the exhibition theme, advocated viewpoints, visual style, works and authors. Second, the organisation of offline art exhibitions consumes a large amount of manpower, material and financial resources, and most visitors are professionals in the art circle. The general public connection outside the professional circle is relatively weak. Further exerting the exhibition culture to enhance the communication value of social aesthetic education and establishing a long-life link between the exhibition culture information and the public is worthy of deep consideration.

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2. Theoretical basis

2.1. Information flow of exhibition culture

According to the semiotic perspective, "information" generally refers to all content disseminated by human society, including objective news of things and abstract information concepts, such as thoughts, concepts, and emotions derived from subjective human society. Information is the basic component of human social development. The emergence of all information is the culture of human society. The essence of the design of the cultural derivatives of the exhibition is to revolve around the product carrying the exhibition's cultural information. Through a series of spontaneous information dissemination behaviours after user population purchases, cultural information can still be circulated in society after the exhibition period is over, thereby continuing the exhibition, the life of the exhibition and the promotion of the exhibition's aesthetics. Therefore, the hierarchical disassembly of the exhibition's cultural information to clarify the cultural information content that the product design should carry in the design practice is an important link in guiding the design of the cultural derivatives of the exhibition.

2.2. Philosophy of long-life design

In today's rapid social development, the people's material pursuit is gradually improved, and the concept of innovation and creativity is constantly instilled in us. Because the creation behaviour is directly related to the industrial economy, if there is no new supply, the market is likely to be gradually lost. This has also caused huge social and natural problems. In today's society, innovative and well-designed products are likely to be overdesigned, such as clothing. These products need to consume a large amount of the limited resources of the earth, and thus, the environment that humans rely on for survival is becoming worse. Based on this, another design method proposed by Japanese designer Nagaoka Kenmei is "long-life design." [1] The point of view of long-life design is to resist the use of new materials to "create," constantly think about and explore the new value of old objects, use the "not new" design method and breed new designs through recycling and recycling under the premise of resource reuse.

2.3. The flow of exhibition information and design symbol mapping

This study is based on the information flow path where "users obtain the cultural information carried by the product through purchase-frequent use to obtain the perception of the cultural information carried by the product-users who are willing to share the information to spread," combined with the design value of product design, the perceptual vocabulary is deduced to the design criteria. "In the process of providing channels for users to purchase information," the requirements for product design are aesthetic appearance, functions closely related to people's lives, and having material sources that follow the long-life design point of view; these are the materials after the exhibition ends. In the process of "making users love to use, and thus, better perceive the information carried in the product," the design requirements for the product are very practical and easy to use. While "users love the product and then spontaneously share the information on the social platform, so that the information can be spread more extensively," the design requirements are as follows: The product is long-lasting and can

even last a lifetime. This product enables users to have a strong sense of identity and a sense of belonging to the social group, reflecting the user’s extraordinary taste and the limited and unique nature of the product.

In design semiotics, the basic symbols of product design are positioned as "shape, material, and colour". The five aspects of “colour-colour texture, form-shape, use-function, and meaning-meaning construction” (as shown in the following figure) are used to guide the subsequent design experiments described in the text.

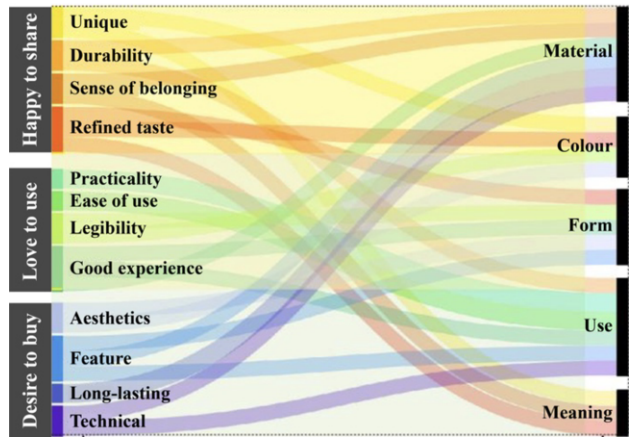


Figure 1. Design Criteria Mapping Relationship of Cultural Derivatives Design Symbols

3. Design preparation

3.1. Material selection

Derivatives are designed based on the one-time materials that contain and continue the life of the exhibition after the end of the art exhibition. We conduct basic tests and comprehensive evaluations by reusing common materials, such as PVC inkjet cloth, adhesive posters, transparent acrylic panels, wood panels, brochures, and chevron panels, which are recovered from art exhibitions. The main visual display of the offline PVC printing cloth is used as the raw material. Combining the basic characteristics of the material, the product function focuses on the bags that are closely related to people’s lives, are diverse in commuting scenes, and exhibit strong mobility. From the perspective of information circulation, through the users’ daily use, the cultural information of the exhibition is provided with more opportunities to circulate among a wide range of people.

Inkjet cloth is a light box sign fabric composed of two layers of PVC and one layer of high-strength mesh cloth, also known as advertising light box cloth, which has good water resistance and airtightness. In China, the existing method of disposing PVC spray-painted cloth after the exhibition period is to transport the PVC spray-painted cloth to the major waste incineration sites through the waste collection and transportation station and then burn or dump the PVC spray-painted cloth in a landfill. The contradiction of the “disposal as rubbish” approach is that the main visual of each art exhibition is a collection of excellent designers from all corners of the world, showing the main visual designer’s design thinking and aesthetic skills.

Because this material carries the main visual design of the exhibition, during the creation of the secondary design, the arbitrary fragments of the material maintain the outstanding visual effect, which reduces a considerable part of the design cost for the secondary design. In addition, recycled PVC inkjet prints for art exhibitions are uniquely endowed with stories and unique attributes. The storytelling carried out by each art exhibition includes the specific theme and unique background of each art exhibition. The cultural derivatives redesigned from this material also continue to tell the story from the exhibition and extend the memory of the exhibition. Each piece of material has its own unique time and space and the main visual graphic of the exhibition. After being designed into a product, each piece of cutting also has a limited number of patterns and colours, and the resulting cultural derivatives are unique.

3.2. Preliminary testing of materials

Using the first recycled PVC inkjet cloth (which belongs to the low-cost warp-knitted inkjet cloth) of the “2019 Design Intelligence Award” as the original test material, the material test of the product design mainly focuses on the material.

First, we observe whether the use of daily disinfectant cleaning agents (84 disinfectant solution, 75% alcohol) and the daily chemical and seasonal objects that potential users may carry (e.g., make-up remover, etc.) will cause surface corrosion and fading. The test results show that the surface of the material remains stable without corrosion, and there is no fading. Further processes that may be involved in the subsequent production of the product, basic tests on the surface of the material, such as UV printing, hot stamping, laser cutting, and sewing, are carried out. In the test process using UV printing, because the recycled PVC inkjet cloth itself carries the inkjet visual elements, it is necessary to create a blank space on the printed part by 100% and then print a new round of the information in colour. When the height of the colour printing pad is 300%, the information printed in the new round will show a considerable height, and the touch has a substantial convexity. It should be noted that if a new round of UV printing is performed on the PVC inkjet cloth, if it is folded multiple times, it is easy for the fold to rupture. In the hot stamping printing test, it was found that the minimum line of the copper mould opening was 2 mm, and the hot stamping effect of copper moulds smaller than 2 mm was not good. During the laser cutting test, it was found that the machine parameters of the laser cutting inkjet cloth were approximately 2 kW, and the speed was less than 24 m/min in the range of 0.1–0.4 mm. However, due to the PVC material, the long-life high-temperature motion of laser cutting accelerates the volatilisation of the plastic toxic gas, so this option should be abandoned in the subsequent process selection. Finally, during the material stitching process, it was found that the warp-knitted inkjet fabric itself has poor tensile strength, resulting in fragile folding and low endurance. Therefore, in the subsequent product design, it is necessary to have existing fabrics with good properties on the market as the lining for stitching to make up for the poor tensile properties of the PVC inkjet fabrics. After the author’s visit to the auxiliary material market, the lining of the basic series of products was finally selected as the auxiliary material of the snow twill fabric with strong bearing capacity, waterproofing and anti-fouling properties.

4. Product design test

Based on the five aspects of the design symbol “material-colour-form-use-intention” proposed in this study, the experiment of “material” includes the lamination test of material, the test of fracture strength, and the test of surface friction, as well as priority visual ordering and the segmentation principle. The intention experiment path of a “shape” is distributed through the internet channel, where the user’s “random intention vocabulary questionnaire for the package” is programmed in JavaScript React to obtain the data and use the EViews tool to assist the analysis to determine the user’s expectation of the product formation. “Using” the user’s behaviour and scenario enables the design analysis of the target crowd to be carried out. The “intention” transmission creates the exclusive electronic file interface for each product through the online HTML5 page.

4.1. Material-material test

4.1.1. Lamination test

- **Test equipment**

A thermal transfer machine is used to cut several pieces of warp-knitted inkjet cloth and a woven inkjet cloth with a size of 500*250 (mm). The technical parameters of thermal transfer printing used in this study are as follows: voltage 220 V/110 V, power 1600 W, temperature range of 0-250 °C, table size of 380*380 mm, and weight of 23 kg.

- **Test principle**

The test is performed with a gradient of 150 °C as the base temperature and 5 °C as the increment or decrement. Because the production process of the product prototype is a semimanual process, considering the labour cost, the number of layers in the lamination test ranges from 1 to 5.

- **Test results**

Due to the thickness of a single layer of PVC inkjet cloth, the hot press can only penetrate two layers of material for compression moulding, while the lamination of more than two layers requires two layers to be laminated and then laminated again. The optimal pressing parameters are as follows: 2 layers of warp-knitted inkjet cloth -160. Pressing for 4 positive and negative repetitions at 2 layers above -200 °C for 30 s; 2 layers of woven inkjet cloth-185 °C for 35 s; 2 layers above-220 °C for 35 s forward and backwards pressing repetitions.

Measured with an electronic Vernier calliper (unit: mm, error within ± 0.05), the warp-knitted inkjet fabric has a thickness of 0.27, a thickness of 0.52, a thickness of 0.88, a thickness of 1.74, and a thickness of 5 layers. For the woven inkjet cloth, the material thickness of one layer is 0.35, the thickness of the two layers is 0.72, the thickness of the three layers is 1.13, the thickness of the four layers is 1.85, and the thickness of the five layers is 2.11. According to the comparative observation of the material before and after pressing, the surface texture of the material after pressing is more prominent, and the hardness and wear resistance are considerably improved.

4.1.2. Fracture strength test

One piece of warp-knitted inkjet cloth and one piece of woven inkjet cloth, each of which has a size of 500*1000 (mm), are formed by laminating 1 to 5 layers, and each piece of sample material is numbered.

- **Test principle**

Three small pieces of 200*500 (mm) specimens were cut from the 1, 2, 3, 4, and 5 layers of material and fixed on the fracture strength testing machine, and each time the small piece of sample material was broken by the machine, the results were recorded on the computer panel. Finally, the average value of the displayed force is the fracture strength of the sample material.

- **Test results are presented as follows:**

Table 1. Test results of fracture strength for different numbers of laminations

Sample	#A #B	Indoor℃	20	Size mm	500*500
Material	#A Warp knitted printing cloth #B Woven inkjet cloth	Humidity	60	Time	2022/1/16
Results					
Breaking strength (N)	Number #A	N	Number #B	N	
	#A01	187	#B01	1444	
	#A02	614	#B02	2960	
	#A03	925	#B03	4683	
	#A04	1991	#B04	> 5000	
	#A05	2005	#B05	> 5000	

According to the fracture strength test results, the fracture strength of the first layer of the warp-knitted inkjet fabric is 187 N, the fracture strength of the second layer is 614 N, the fracture strength of the third layer is 925 N, the fracture strength of the fourth layer is 1991 N, and the fracture strength of the fifth layer is 2005 N. The fracture strength of the first layer of the woven inkjet fabric is 1444 N, the fracture strength of the second layer is 2960 N, the fracture strength of the third layer is 4683 N, and the fracture strength of the fourth layer and the fifth layer is greater than 5000 N. Materials with different stacking numbers have different bearing capacities, which provide an objective data reference for various usage scenarios, placement items, and subdivision requirements corresponding to the design iteration of the bag.

4.1.3. Colour fastness to rubbing

- **Test principle**

A Two small pieces of 200*500 (mm) specimens were cut out of 1, 2, 3, 4, and 5 layers of material and fixed on the rubbing fastness tester. The rubbing head of the machine was rubbed back and forth with a dry white cloth and a wet white cloth. Finally, the white cloth control colour card was removed, and the colour depth from the rubbing of the white cloth was divided into 1-5 levels from dark to light. The larger the number is, the better the colour fastness for rubbing.

- **Test results : see Table 2.**

Table 2. Colour fastness to rubbing test results

Sample	#A #B	Indoor℃	20	Size mm	500*500	
Material	#A Warp knitted printing cloth #B Woven inkjet cloth	Humidity	60	Time	2022/1/16	
Results						
	Number #A	Dry	Wet	Number #B	Dry	Wet
Color fastness to rubbing (level)	#A01	3-4	3	#B01	3-4	3
	#A02	3	3	#B02	3-4	2-3
	#A03	3	2-3	#B03	2-3	2-3
	#A04	3	2-3	#B04	3	3
	#A05	3	3	#B05	3	3

According to the test results of colour fastness for rubbing, the colour fastness for rubbing of the two different types of inkjet cloths with different stacking numbers was not substantially different, and both remained at approximately level 3.

4.2. *Colour-material visual segmentation and matching principle*

4.2.1. *Visual segmentation sorting*

We deconstruct the vision of inkjet printing based on the information recognition, information integrity, and information accuracy presented in the final product. Two pieces of exhibition inkjet printing cloth are selected and numbered (A, B) for visual hierarchical disassembly to draw a visual hierarchical spatial map and a thermal map, as shown in Figure 2. The inkjet cloth numbered A is recovered as the main visual for the “2021 China Academy of Art Design and Art Graduation Exhibition,” and the inkjet cloth numbered B is recovered as the main visual for the 3rd Zhijiang International Youth Art Week of the “Present History.” The spatial deconstruction map uses 400*400 mm as the basic unit for visual segmentation. In the hierarchical thermodynamic map, red represents the proportion of primary vision in the entire inkjet cloth, orange represents the proportion of secondary vision in the entire inkjet cloth, and green represents the proportion of tertiary vision in the entire inkjet cloth.

According to the above figure, the graphics or text that are complete, strong in visual impact, and do not appear repeatedly in one square are the first-level visual elements. The large area is segmented into several squares and appears repeatedly and continuously. The visual graphic text is the secondary visual element, and the solid colour vision divided into several squares is the tertiary visual element. According to the proportion of different colours of the hierarchical heatmap in the entire inkjet cloth, it can be predicted that the product with a larger area of red and orange inkjet cloth will be more popular with users.

4.2.2. *Cutting matching principle*

Based on the visual segmentation priority and the damaged condition of the inkjet layout, the product’s cutting priority with recycled inkjet printing cloth as the raw material is designed in the order of intact level 1 vision part, intact level 2 vision part, and intact level 3 vision part. The final part is a damaged local part (set as the 4th level).

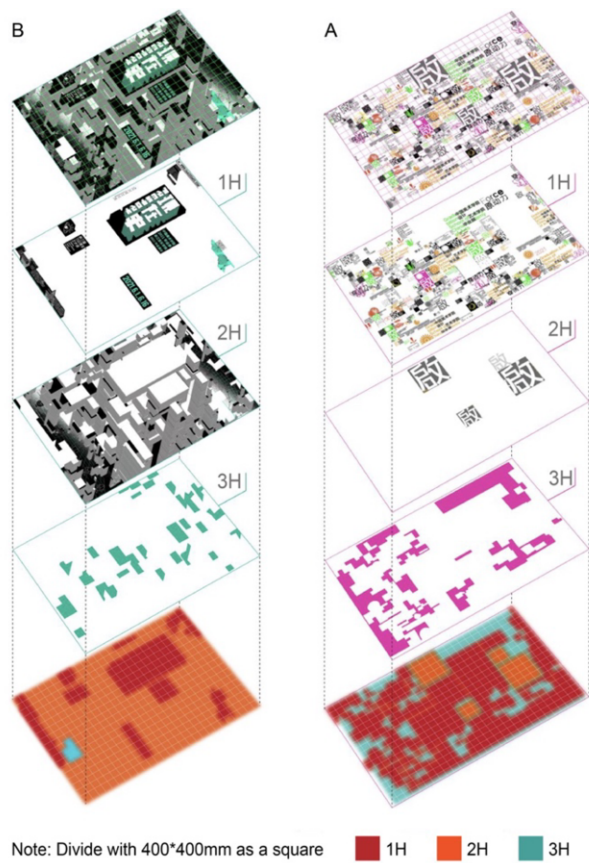


Figure 2. A and B visual space deconstruction map and hierarchical heatmap

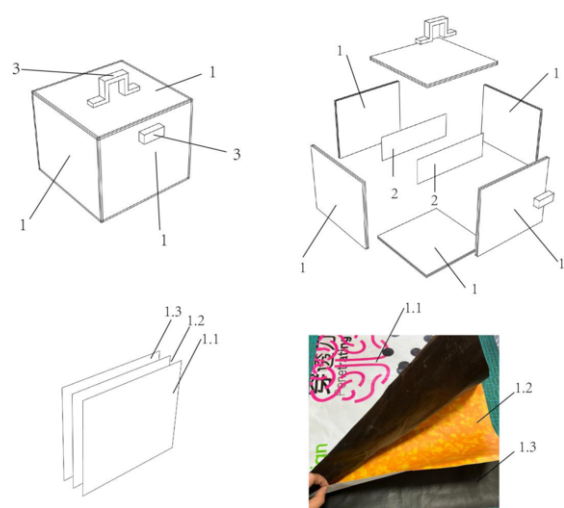


Figure 3. Box intention structure of the package

The packaging product is treated as a box, and its key parts are marked. Mark 1 is the outer layer of the bag, 2 is the inner pocket, 3 is the small parts, such as the opening and closing or handle, and 1.1 and 1.3 are the outer layers of the cloth. The laminated outer layer material of 1.2 is the laminated centre material of the outer layer of cloth.

Figure 3 shows the visual parts of the 1st and 2nd levels of the inkjet cloth at the outer layer of packages 1.1 and 1.3; 1.2 shows the visual parts of the 3rd level and the damaged parts of the 4th level. The selected material for Part 3 is the residual material of the visual material of the 1st to the 3rd levels.

4.3. Form-User Random Intent Vocabulary Questionnaire Experiment

4.3.1. Test path

The purpose of this experiment is to clarify the product expectations and intentions of the target users and provide clear guidance for the subsequent design, which is carried out by combining the perceptual vocabulary decomposition and logistic regression in the perceptual engineering design. Logistic regression is a generalised linear regression model that is often used in data mining and economic forecasting problems. It is a classification model, and it is often used in a two-class model. Considering that the purpose of this experiment is to explore the impact of different perceptual words describing the characteristics of a computer bag on the user’s preference, from the user’s perspective, the final judgement result is the binary classification of “like” or “dislike,” so it is more suitable for use. The logistic regression method is used for the study.

• Test process

In this study, first, the relevant perceptual impression vocabulary is collected, and then the memory vocabulary is screened. Then, the questionnaire generated by the random vocabulary of the screened perceptual vocabulary is programmed to form the interface of descriptive sentences and is presented to the testers. They use descriptive sentences in the interface to make judgements. After the questionnaire is written, a preliminary test is conducted. Experts in the field and ordinary users are selected to answer the questions, and suggestions for improvement and optimisation are proposed. If the preliminary test passed, the formal test phase begins, and the random perceptual vocabulary questionnaire is distributed to a specific population. After the questionnaire data are collected, regression analysis is performed. Finally, the data results are analysed, as shown in Figure 4.

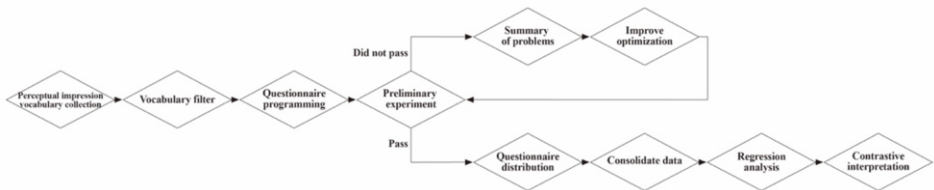


Figure 4. Test path of the perceptual vocabulary random test based on the logistic regression method

• Test method

①The vocabulary of adjectives related to the appropriate design intention based on the user’s psychological feelings from magazines, advertisements, and news about

the package is collected, and use subjective judgement is used to filter out adjectives that are not commonly used or have similar meanings to form representative intentional adjectivesp[2].

②The vocabulary of representative adjectives (under the overall simple framework) is classified according to the four categories of “shape-shape-shape style, colour-colour-coverage figure, use-function-use form, material-material-texture texture” with a corresponding description. The adjectives with intent are combined and drawn into a random vocabulary table, as shown in Table 3.

Table 3. Colour fastness to rubbing test results

Shape (style)	Elegant	Neutral	Sporty	Cute
	Funny	Individual	Fashionable and exaggerated	Handmade
Color (covered)	Special text	Exhibition logo	Solid color	Color block
	Private information	Surface customization of bags	Bright	Detailed information
Use (form)	Carried on the shoulders	Can be slanted	Portable	One shoulder
	Removable	Compartment	Easy to store	Save space
Material (texture)	Stiff	Smooth	Heavy	Exquisite
	Textured	Rounded	More accessories	Uniform material

③Using random thinking, the adjective words in the random perceptual vocabulary table are randomly labelled with 0 and 1 to form a complete descriptive language presented in the front-end random vocabulary questionnaire interface. The subjects who participate in the questionnaire can choose “like” or “dislike” according to the words of the descriptive adjectives that appear randomly. The adjectives marked with 1 are positive, corresponding to the descriptive words that appear in the random vocabulary questionnaire; the adjectives marked with 0 are negative, and the corresponding descriptive words appear in the negative of the random vocabulary questionnaire.

④Data are collected and analysed.

4.3.2. Questionnaire programming and distribution

The random vocabulary questionnaire is created using the React framework of JavaScript.

The front-end of the questionnaire is written using the JavaScript-based React framework. A keyword list is randomly generated for the perceptual impression adjectives and rendered on the webpage through the dynamic rendering mechanism of React. Through the web interface, the questionnaire asks respondents whether they like the written intention of the keyword description. After the answer is complete, the keyword list is packaged through JavaScript, including the user ID, subdivision identity, and response information, and sent to the back-end database, as shown in Figure 5.

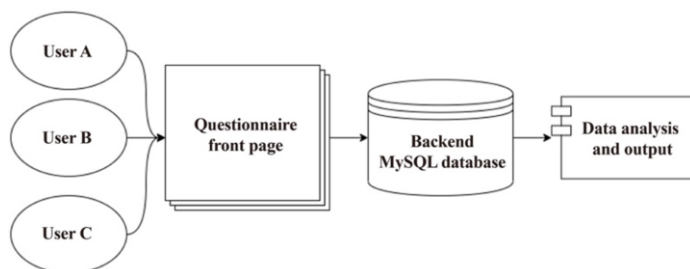


Figure 5. Technical path of the “Users’ Random Intention Vocabulary Questionnaire” in JavaScript React Programming

• Preliminary test

① Purpose of the experiment: To obtain direct feedback and professional suggestions from the subjects during the experiment and to understand the rationality of the preset perceptual vocabulary.

② Subjects: A total of 4 subjects. Among them, there are 2 professionals with a design background (1 digital designer, 1 experienced designer), 1 data analysis engineer, and 1 general user without a design background.

③ Experimental environment: A random vocabulary questionnaire is sent online to answer the questions independently.

④ Test results: The following problems are found in the preliminary test, optimised and improved.

Question 1: Excessive vocabulary, resulting in cumbersome and difficult to understand random vocabulary questionnaires for the tested users.

Question 2: The semantic word description is too abstract, and it is impossible to determine which part the adjective describes.

Question 3: Some words are too positive or negative.

Question 4: The user’s identity is not subdivided, and the test results cannot be compared.

• Test correction

② The vocabulary of the random intent vocabulary table is deleted and adjusted.

② In the questionnaire, the user segmentation of the experimental personnel of a specific population is added, including art college teachers, art college students, business workers, vintage enthusiasts, environmentalists, independent curators, and the modified random sensibility. The vocabulary questionnaire is shown in Figure 6.

• Formal test

① Test purpose: To confirm the preference of “shape, colour, material, and use” of the final product among specific users.

② Subjects: It is expected that 1,000 copies of the questionnaire will be collected.

③ Experimental requirements: The random intentional vocabulary questionnaires are distributed through the keyword communities #ART Lover, #ART Exhibition, #Gu zhuo Community, and #environmentalist on various social platforms. Due to the

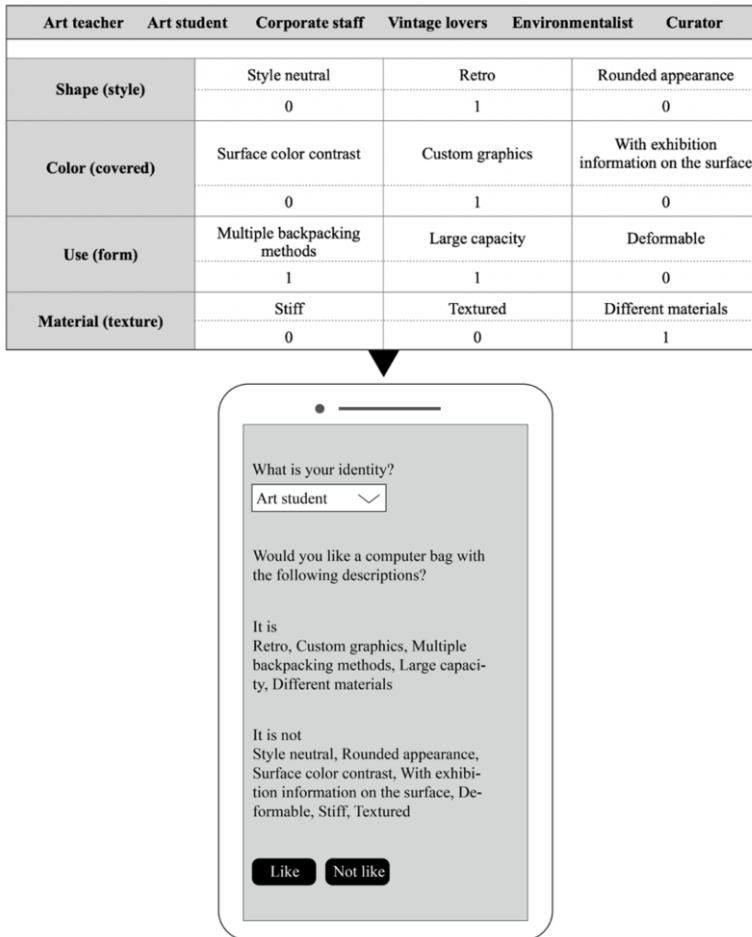


Figure 6. Schematic diagram of the generation logic of the “users’ random intent vocabulary questionnaire on the package” in the formal test of JavaScript React programming

distribution of online questionnaires, the subjects are asked to distribute the questionnaire. They cannot interfere with each other.

④Test results: A total of 2636 valid data points are recovered.

4.3.3. Data analysis

• Test data calculation and results

The analysis is performed to confirm the final product among specific users using the statistical tool Eviews 10. Logistic regression analysis is performed on the total 2636 data points and the subdivided population data. In this study, two categories are used, and the response variables are only like (1) and dislike (0).

Logistic regression is based on the idea of probability, assuming that the probability of the response variable is 1 is p .

That is: $p = \Pr(y = 1|X)$

Constructed:

$$\text{logit}(p) = \log \frac{p}{1 - p}$$

The regression equation can be established as follows:

$$\text{logit}(p) = \beta_0 + \beta_1 \times X_1 + \beta_2 \times X_2 \dots + \beta_{12} \times X_{12}$$

In addition, the logistic regression is based on the probability regression model, so the maximum likelihood method is used to estimate the parameters of the logistic regression. The results of the overall sample are as follows:

Table 4. EVIEWS total sample data analysis results

Variable	Coefficient	Std.Error	z-Statistic	Prob.
C	0.7925	0.1574	5.0329	0.0000
X1	0.0308	0.0874	0.3524	0.7245
X2	0.3074	0.0872	3.5245	0.0004
X3	-0.0699	0.0873	-0.8010	0.4231
X4	-0.0243	0.0872	-0.2677	0.7889
X5	-0.1434	0.0873	-1.6433	0.1003
X6	-0.2960	0.0875	-3.3824	0.0007
X7	0.1809	0.0872	1.0837	0.2785
X8	0.0947	0.0873	1.0837	0.2785
X9	0.0258	0.0873	0.2951	0.7679
X10	0.0376	0.0873	0.4304	0.6669
X11	0.0515	0.0872	0.5903	0.5550
X12	0.1030	0.0873	1.1798	0.2381
Total obs	2636			ALL

Table 5. Variables of the random intention vocabulary questionnaire

X1	X2	X3	X4	X5	X6
Style neutral	Retro	Rounded appearance	Surface color contrast	Custom graphics	With exhibition information on the surface
X7	X8	X9	X10	X11	X12
Multiple backpacking methods	Large capacity	Deformable	Stiff	Textured	Different materials

The equation form is as follows:

$$\text{logit}(p) = 0.7925 + 0.0308 \times X_1 + 0.3074 \times X_2 \dots + 0.1030 \times X_{12}$$

From the above regression results, the variable, X2, is significant at the significance level of 10%, and the coefficient is positive, i.e., under the condition that other variables remain unchanged; the bag with the retro feeling has a greater probability

of being liked by all users. Variable, X7, is significant at the significance level of 10%, and the coefficient is positive, i.e., under the condition that other variables remain unchanged; packages with multiple methods have a greater probability of being liked by all users. Variable, X5, is at the significance level of 10%, which is more significant, and the coefficient is negative, i.e., when other variables remain unchanged, there is a greater probability of being liked by all users without customising the package surface. The variable, X6, is at the significance level of 10%, and the coefficient is negative under the condition that other variables remain unchanged; the package surface without exhibition information has a greater probability of being liked by all users. Subsequently, logistic regression analysis of the subdivided populations is performed one-by-one.

- **Data summary and analysis**

Overall, the conflict between the results of the regression logistic data calculation and the market test is focused on the variable, "X6 and whether the package plane carries exhibition information." The results of the random questionnaire on perceptual vocabulary show that under the condition that other variables are unchanged, the package with exhibition information is not liked by the majority of the target users. However, in the actual market test and sales, it reflects that the package is carrying the exhibition logo and the exhibition. The text information and main visual local graphics are the most popular. Therefore, selecting the questionnaire has a certain degree of limitations, and the subjects all make judgements and choices based on their existing cognition. Therefore, product innovation can often be transformed into a surprise in a context that no one expects. In addition, for the iterative design of a computer bag, the key elements of the design should have a retro feel, large capacity, variable bag body, multiscene use, and multiple backing methods.

4.3.4. Collection and refinement of styling semantics

In the book, two industrial designers were invited to select the package template with retro intention, and the intersection selected by the third was used as the reference diagram of the styling intention. Among them, the most frequently selected bag template has the characteristics of rounded corners, envelope shape, double shoulder strap, shoulder strap drop-shaped interface, flap opening and closing, and a small number of metal parts. On the basis of retaining the previous product design elements and under the premise of simple and neutral brand tonality, the intent graphics of each part of the bag are selected for reference, as shown in Figures 8 and 9.

4.4. User behaviour and scenario demand analysis

From the three types of subdivided users of art college teachers, art college students, and business workers, we conduct a survey based on the daily "commuting scene, transportation mode, and carrying items, and the corresponding design points are extracted." Among them, the commuting scenes of college teachers and corporate workers are more diverse, including commuting from home to the company and on business trips. Among them, the commuting scenes of corporate workers are also common on the corporate campus. College students commute in a relatively simple way, that is, from the dormitory or home to the school. The transportation mode for university

teachers and enterprise workers is mostly private vehicles and occasionally travel by high-speed rail or plane. In addition, enterprise workers usually ride on bicycles, walks or electric scooters in the park for meetings, while it is more common for college students to use public transportation. There are transportation modes, including electric vehicles, bicycles, and shared scooters in schools. The common items of the three user groups are computers, pens, notebooks, and books. Due to the needs of business trips, college teachers and business workers occasionally need to bring clothes. The difference is that student groups need to carry special equipment, such as design materials and painting materials, and those working in enterprises often need to carry work materials.

In summary, by meeting the user's physiological and psychological needs of the product, the following design points are extracted: for the first design point is that the package surface is with the main visual image of the exhibition; the size of the package can be adjusted; the package can be worn in a variety of ways. In addition, a small number of gold metal parts are used as functional and decorative accessories in the computer liner bag to meet the needs of a variety of scenarios.

4.5. Design of electronic archives embedded in the ontological information of the exhibition

To broaden the aesthetic education vision of "enabling art exhibitions into thousands of households" in the design purpose and to solve the time and space problem of limited recycled materials, a unique "electronic file in the form of two-dimensional code" is embedded in each product. The two-dimensional code is printed on the surface of the product package using the UV printing process, which is the only entrance to the private "electronic file" of the virtual space, and the front-end page of a webpage is finally presented to the user. This page uses the corresponding physical product as the entrance, carrying the entire process of the physical product from inception to transformation, and is displayed in front of the user in the form of a story line; then, the user can freely share its story on the social platform. The design and printing of electronic archives store offline exhibitions online, forming an exhibition that never ends and better spreads the ontology information of the exhibition using the internet.

The electronic file includes the private discourse of "digital seal cutting" in the user's customised information, the virtual image of each product, the local positioning of the product in the entire PVC printing cloth, the size, the place of production, the degree of wear, and the use of the product, which explains the main information of the exhibition, such as the precautions, the brand story, and the online exhibition link relevant to the exhibition.

"Praise of All Wills-Online Epidemic Teaching Exhibition of China Academy of Art" is taken as an example, as shown in Figure 7. When cutting, according to the background, the visual source file of the PVC inkjet cloth is coded with the horizontal axis as the capital letter and the vertical axis as the Arabic numerals to encode each piece of cutting material and embed it into the corresponding physical product. The online web address embedded in each physical product in the form of a two-dimensional code permanently carries and records the digital seal cutting off the user's private discourse within 20 characters, which also contains the code of the corresponding physical product ("20-SOS-HZ-A03"), as well as the online virtual image corresponding to the physical product. The product pattern is marked in the position of the entire poster; the user clicks on the corresponding partial pattern of the product in the entire poster, and the interface pops up to display the basic information of the product attributes and process record

information of the physical product, including the product size and the main visual designer of the exhibition. Next, the user can click on the link to enter the online exhibition hall of the exhibition and the personal work website of the main visual designer of the exhibition.

4.6. Product design

4.6.1. Material selection

"The materials for the iterative product design were selected from two 50-square-metre PVC inkjet fabrics that were recycled in the "The 3rd Zhijiang International Youth Art Week" and one piece of 29-square-metre from the "Graduation Exhibition of the School of Design and Art of China Academy of Art in 2021"." PVC inkjet cloth is the main material; the large-area solid-colour parts of the "Lecture Series of Innovative Design School of China Academy of Art in 2020" and "The Global Official Screening of the VR Unit of the 77th Venice International Film Festival | China Station" are used as auxiliary materials to carry out iterative product design. One of them is woven inkjet cloth, and the rest are warp-knitted inkjet cloth.

4.6.2. Main product design presentation

- **Multiback computer liner bag design**

The multiback computer liner bag uses a three-layer laminated PVC printing cloth, which improves the hardness and wear resistance of the product. The pockets for objects such as pens and pens are shown in Figure 8.

- **Deformable bag design**

Considering that the flexible laptop computer is designed for the use of multiscene and multiback methods, two bags of different sizes are designed, which are made by combining two layers of laminated PVC inkjet cloth, as shown in Figure 9.

Adhering to the use of recycled fabrics in the largest area, the square-based design shape is retained. Considering the specific usage scenarios and the items placed in the usage scenarios, the product design has made a fine separation layer in the bag's body, and the location and size of the compartments are made to consider the convenience of the user with a bandage for the trolley case. The product design has the functions of a foldable cap, a detachable strap, and an internal specific compartment. Specifically, the pen and the computer charger are separately designed on the back of the bag, and a laptop is mainly placed inside.

Second, according to the different sizes of bags and the items placed in the preset user scenarios, the subdivided parts of the bag are made of different layers and types of PVC inkjet cloth. Therefore, 2-3 layers of warp-knitted inkjet cloth with moderate thickness and good flexibility are used. There are more daily items in the bag, and better load-bearing and wear resistance properties are needed. Therefore, 3-4 layers of woven fabrics are selected. Inkjet cloth is the best material. In addition, in the load-bearing part of the bag, the fabric strength, is improved by increasing the stitch density, thereby improving the quality.

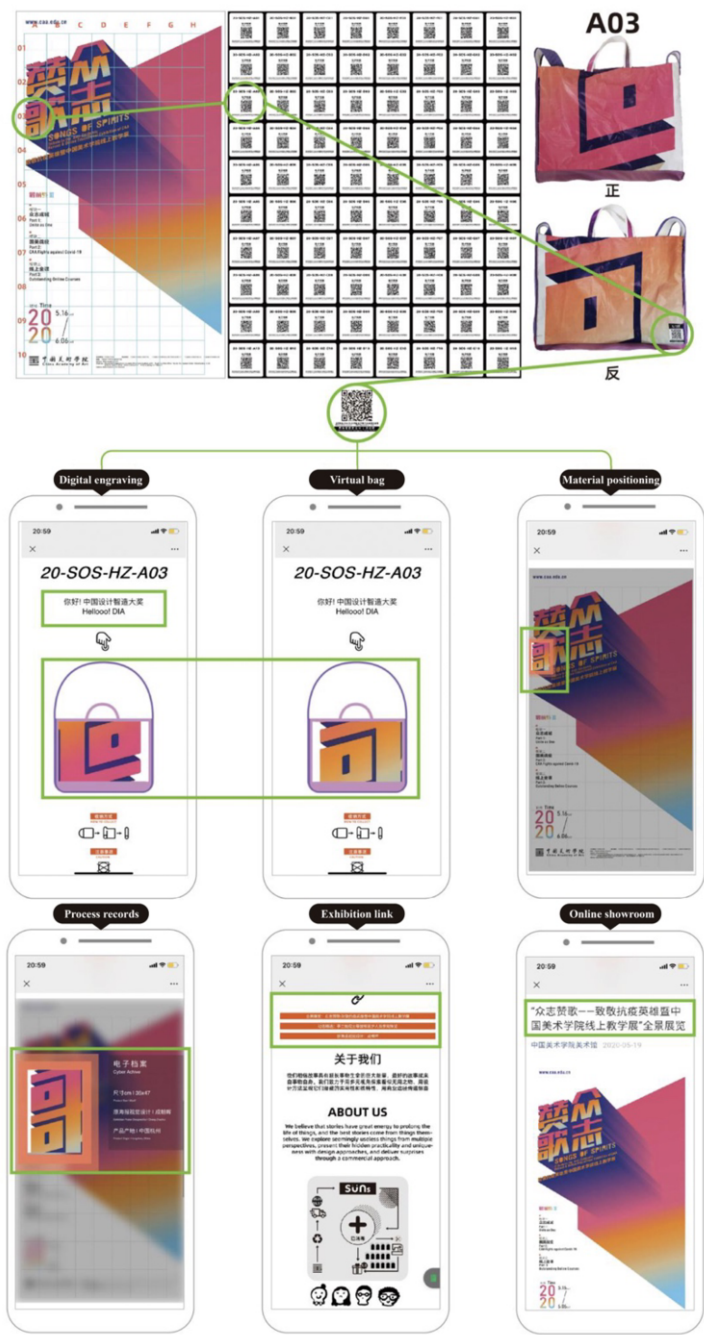


Figure 7. Design of the electronic archive interface of the “Praise of the Public” series

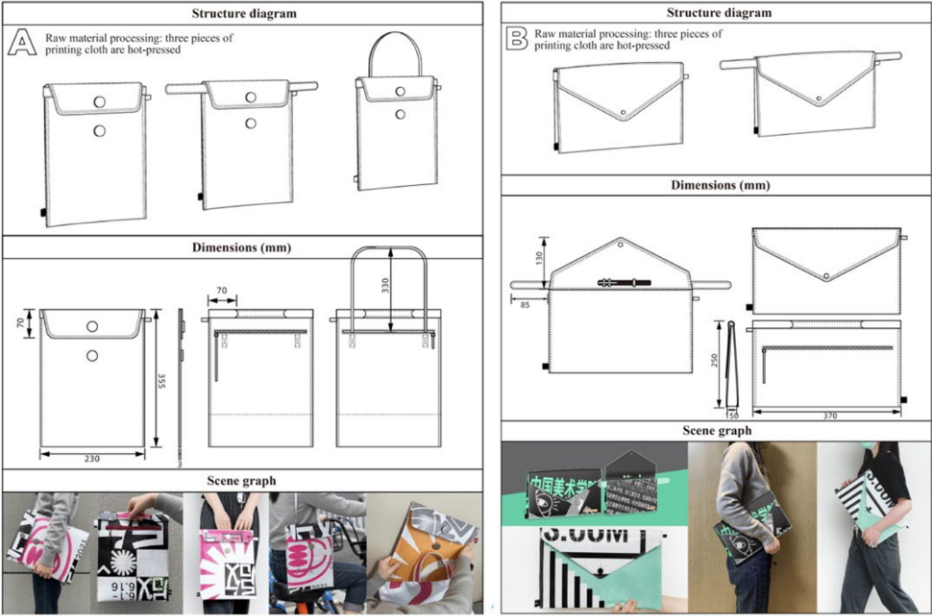


Figure 8. Models A and B Design of the multiback computer liner

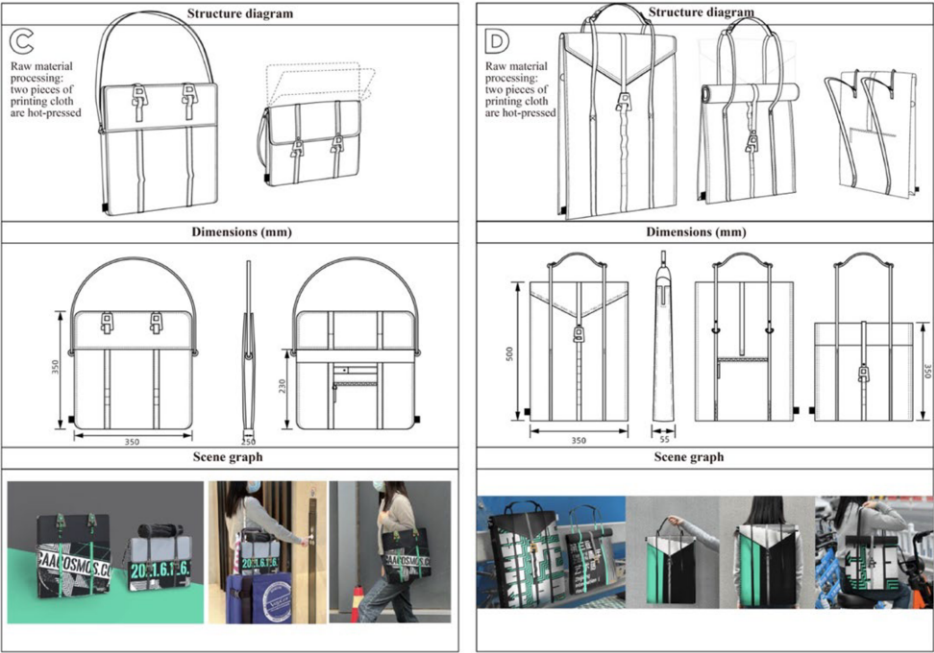


Figure 9. Models C and D are carrying the available deformed bag design

In the production of the lamination process, the cut material sheet carrying the exhibition logo, text information, and main visual graphics is pressed to the outermost layer, and the solid colour sheet is pressed to the centre layer. In addition, the raw materials of the small-size components, such as the handle of the bag and the detachable strap, are made from the leftover material after cutting a large piece of material. The product uses a small amount of metal accessories, which not only act as a functional accessory but also enhance the product quality.

4.6.3. Design and presentation of accessory products

In the above research process, it was found that in addition to the demand for the function of the bag, the largest demand was for the notebook. The notebook and the main product package are complementary to each other, which not only matches the product function and form to meet the various daily needs of users but also expands the possibility of the functional design of the cultural derivatives of the exhibition materials. Combined with the common dimensions of the remaining materials, the design was developed in the two most commonly used sizes, A5 and 200*100 mm.

4.7 Integrated process

First, the materials are recovered from the disassembly of the materials after the exhibition. After the materials are sorted and disassembled and the heavily damaged or unneeded parts are disassembled, the fabrics are first cut into large pieces, usually with an area of 2*2 m. Then, some of the materials are stored, and the other part is cut according to the size of the design draft. Next, the cut materials are cleaned, disinfected, dried, and sorted according to visual priority. The design needs to suppress the pressing with different numbers of laminations. After the material is cooled, the specific cutting is carried out according to the different design patterns. When the material of one layer is cut according to the design drawing, only the ordinary sewing machine is needed, and the material to be laminated needs to be sewn by the heavy industry sewing machine or the leather sewing machine. After the laminated material is sewn, the edges of the finished product are continuously corrected and polished.

5. Summary

Based on the long-life design philosophy, the textual research continued the life cycle of the exhibition through innovative creative designs after the exhibition. "The evolution from to "product" and then to "commodity" has opened up an innovative path for exhibition culture to further enhance social aesthetic education and broaden the design ideas for researchers engaged in long-life design and green design. It is hoped that more partners will join this study in the future to provide more exhibition-related resources, product design processes and supply chains. In the future, the expansion of product categories will continue to explore stationery and furniture. At the same time, researchers in related fields are expected to conduct research on the development of sustainable alternative materials for the production source of PVC inkjet cloth to better solve the problem of material contamination at the source.

Acknowledgements

This work was supposed by the Art Key Grant Project of National Social Science Foundation of China (Grant No.20ZD09), and Design-AI lab of China Academy of Art, and Design Discipline Young Design Talent Cultivation Project of China Academy of Art 2022.

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