

Research on Application of Sustainable Design Thinking in Clothing Design

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Abstract: The green transformation of the garment industry is an inevitable choice to conform to the development of The Times. The application of sustainable design thinking in the garment design has become an important path to solve the problem of harmonious coexistence between the industry and the environment and the society. In this study, various research methods, such as literature review and case analysis, are adopted to systematically review the practical cases in the field of sustainable garment design thinking in recent years, and through in-depth analysis, three methods of sustainable garment design thinking: one is to promote the sustainability of garment design methods, advocate versatility, durability and upgrading design thinking; the second is to ensure the sustainability of garment raw materials, select environmentally friendly, renewable or recycled materials; the third is to strengthen the sustainability of garment production and processing process, and adopt the production process of energy saving, emission reduction and efficient utilization of resources.

Keywords: Sustainable Design Thinking; Clothing Design; Design Method; Clothing Materials.

1. The Concept and Importance of Sustainable Design Thinking

Sustainability design thinking refers to bringing environmental factors and pollution prevention measures into the design in the design stage, taking good environmental environment and sustainability as the design goal and starting point, and striving to minimize the adverse impact of the design on the ecological environment and the society. Sustainable design thinking is not only a reflection on the clothing industry, but also a reflection on the human life style and cognitive thinking at the present stage. In clothing design, sustainable design thinking can guide brands, designers and consumers to pursue a greener and healthier lifestyle, so as to promote the conservation of resources and environmental protection.

Sustainable design thinking plays a vital role in clothing design. It advocates both environmental protection, resource conservation and social responsibility while creating fashion beauty. Through innovative technology and material selection, it not only meets the demand of consumers for environment-friendly clothing, but also promotes the green transformation and upgrading of the clothing industry, leading the future fashion trend to a more sustainable and healthy direction.

2. Application Method of Sustainable Design Thinking in Fashion Design

In the clothing industry, from the design idea to ground production to store sales to the hands of consumers, a series of each step of the process has the foothold of sustainable design thinking, sustainable thinking can be divided into clothing design thinking method sustainable thinking, clothing raw materials sustainable thinking and garment production and processing process sustainable thinking.

2.1. Sustainable Clothing Design Method

2.1.1. Wear More Design

It is an innovative and sustainable clothing design method, which aims to enable a single piece of clothing to meet a

variety of wearing needs through flexible design, so as to extend the service life of clothing and reduce the waste of resources. In the design, we can integrate the sustainable design thinking of wearing more clothes into the design. Specifically, there are many design methods for wearing more clothes, such as removable elements, rope elements and deconstruction elements, which can increase the practicality of clothing from multiple dimensions to meet various needs of different occasions. For example, the "COATOLOGY coat doctrine" series of MACKAGE, a Canadian high-end luxury ready-to-wear brand (as shown in Figure 1), Its "COATOLOGY coat doctrine" series also fully demonstrates the design concept of wearing more than one dress, The coat collection is made of high-performance fiber fabrics, And integrated into the cutting-edge multi-component type design concept, Such as all-in-one, self-heating pocket, removable wind protection hood and other details, These designs allow each coat to cope flexibly with diverse environments and variable temperatures, Consumers can rely on changing weather and wearing needs, Free to combine and adjust the coat style and function, Increasing the frequency of the use of clothing also realizes the effect of wearing more than one garment.



Figure 1. MACKAGE Mens 2-in-1 detachable down coat ROLAND



Figure 2. Chanel suit

2.1.2. Classic Permanent Design

Rapid update of the fashion industry has brought a significant problem: clothing out often not because of its physical wear or loss of wearing performance, but because it has not conformed to the current trend, thus consumers as "outdated" and discarded, this phenomenon led to a lot of waste of resources, not only caused the burden to the environment, also wasted the production of these clothing consumed resources and energy. Therefore, in the design process, in order to avoid such waste, we can try to choose a classic design style that is always outdated at any time. For example, the classic LV (Louis Vuitton), with its iconic Monogram pattern and excellent leather craft, has become an outdated classic in the fashion industry. Its design inspiration comes from the past, but it can be skillfully integrated into modern aesthetics, so that LV bag can still maintain its unique charm and value after many years. Another example is the Chanel suit (as shown in Figure 2), which has also become an eternal classic in the fashion industry with its simple and elegant design style. Chanel suit design not only led the fashion trend at that time, but also became the object of the designers of later generations to imitate, proving its aesthetic value across the era.

The existence of permanent design of classic, not only reduces the waste of resources caused by the pursuit of trends, also reminds the fashion industry and designers, real fashion should be able to stand the test of time, at the same time, also guide consumers rational consumption, choose those who can accompany their through years long, really suitable for their own classic style.

2.1.3. Upgrade and Reengineering

In the thinking of sustainable clothing design, the transformation design of old materials and old clothes is a very creative and environmentally friendly design method. This method gives them new life and value by reusing existing materials or clothing. By transforming waste fabrics and outdated clothes into new and fashionable clothing works, we can reduce the waste of resources and environmental pollution, and stimulate consumers attention and enthusiasm for sustainable fashion. For example, Inmans "clothing rebirth" old clothing recycling plan (Figure 3), Inmans environmental protection platform "Clothing Rebirth" and Alibabas "Xianyu" jointly carried out the "old clothing recycling" environmental protection action. A large number of old clothes are recycled both online and offline. After the artistic design, the recycled old clothes continue to accompany consumers in a new form, improving consumers awareness of sustainable fashion.



Figure 3. Inmans "clothing rebirth" old clothing recycling plan



Figure 4. ai generates Korean clothing

2.1.4. Use AIGC Technology to Assist Clothing Design

In the creation process, the transformation of design manuscripts from paper to real objects is often a time-consuming and resource-intensive process, which usually requires a large amount of white blank cloth and samples to preview the final effect of clothing. However, as AIGC (artificial intelligence generates content) technology continues to advance, designers can advance this process more efficiently. AIGC technology can quickly generate highly realistic virtual clothing models based on the designers' initial ideas or sketches, allowing designers to preview the overall effects and details of the design without making physical samples. This technology not only significantly reduces the use of white cloth and samples, reduces costs and achieves sustainability, but also allows designers to adjust the design based on feedback faster, thus more efficiently turning ideas into reality (Figure 4).

2.2. Raw Materials for Sustainable Clothing

2.2.1. Environmentally Friendly Fabrics with Strong Durability

In the field of sustainable clothing, environmentally friendly fabrics with strong durability not only have excellent durability, but also can withstand frequent washing and wear, so as to extend the service life of clothing, reduce waste, and often use environmentally friendly production process. For example, organic cotton is a kind of cotton that is planted without chemical pesticides and fertilizers. Its fibers are long and strong, making clothing that is comfortable and durable. Bamboo fiber (as shown in Figure 5) is famous for its natural antibacterial and air permeability. Meanwhile, bamboo grows fast and regenerates, and is a sustainable raw material. Choosing these durable and environmentally friendly fabrics is an important step towards sustainable fashion.



Figure 5. Bamboo fiber fabric



Figure 6. Sustainable fashion collection of Nine-piece 03

2.2.2. Biodegradable and Harmless Materials

With the improvement of environmental awareness, biodegradable and harmless materials are increasingly widely used in the clothing industry. Such materials can decompose naturally after waste and will not cause long-term pollution to the environment. Common biodegradable materials include bio-based polyester, PLA (polylactic acid) fibers and natural fibers such as hemp and cotton. For example, PLA fiber is fermented from renewable resources such as corn starch (Figure 6), which has similar physical properties to conventional polyester, but can be completely biodegraded after waste.

In the field of clothing design, more and more brands began to use biodegradable harmless materials, in response to the call of environmental protection and sustainable development, such as the German industrial designer Konstantin Grcic and Munich clothing brand Aeance launched a sustainable fashion series called Nine-piece 03, the series of clothing using 96% recycled natural or biodegradable materials, such as merino wool, recycled nylon, beech wood made of flexible fiber, recycled plastic and biodegradable elastic nylon material, etc. By using these biodegradable and harmless materials, we can effectively reduce the negative impact of clothing waste on the environment and promote the sustainable development of the fashion industry.

2.2.3. Recyclable Materials

Recyclable materials come from discarded textiles, plastic bottles or other recyclable items, which are reprocessed into usable fibers or fabrics by high technology. For example,

recycled polyester bottles can be converted into recycled polyester fibers for making clothing. This approach not only reduces landfill and Marine pollution, but also saves resources. Through the use of recyclable materials, the fashion industry can establish a circular economy model to promote the effective use of resources and reduce the pressure on the environment. For example, Pradas Re-Nylon recycled Nylon series launched during the Spring / Summer 2024 International Fashion Week is popular among young people (Figure 7). This series is mainly made of Marine plastic recycling materials, highlighting the brands insistence on environmental fashion.



Figure 7. Prada 2024 Re-Nylon regenerated Nylon series

2.2.4. Biobased Materials

Bio-based materials are extracted from renewable resources such as plants and microorganisms and used to make new materials for clothing. Compared with fossil fuel-based materials, bio-based materials have a lower carbon footprint and more environmentally friendly production processes. For example, some designers use *chlamydomonas reinhardtii* (a single-celled green algae) to spin with nanopolymers to create a lightweight woven ecological textile similar to flax, which can photosynthesize like a plant to purify the air. In addition, designers have used gelatin based on algae (mainly spirulina and red algae) to replace agar to create a new type of "bioplastic" sequins, which are 100% biodegradable, providing more options for clothing design.

2.3. Sustainable Garment Production and Processing Process

2.3.1. Sustainable Process

Sustainable process refers to the use of technologies and methods with the least impact on the environment in the process of garment production and processing, emphasizing that every link of the process from raw material procurement to finished product manufacturing follows the principle of sustainable development. By optimizing the production process, the new technology, using environmental protection materials and promote circular economy, to reduce energy consumption, greenhouse gas emissions and waste, improve the efficiency of resource utilization, realize the sustainable development of brand and economic benefits, to promote manufacturing to more green, low carbon and sustainable

development. For example, in recent years, the Bethany Williams brand has always adhered to the concept of environmental protection and sustainability. In the autumn / Winter 2019 series, Bethany Williams draws on artists paintings and integrates the local people and environment into the design, while using environmentally friendly denim jackets and pants made of organic fabrics. The series of denim jackets are made in different messy patterns, while the pants are made of organic fabric, not only environmentally friendly, but also a unique fashion style.

2.3.2. Zero-waste Cutting and "One-piece Cutting"

Zero waste cutting is a cutting method designed to reduce fabric waste. It refers to the utilization rate of fabric is fully considered in the design stage and make full use of every inch of fabric by optimizing the cutting scheme. The "one-piece cutting" is a concrete implementation of zero-waste cutting, which requires the whole garment to be cut from a complete piece of fabric, without the need to splicing or cut the redundant parts. For example, Mitsuku released its brand "132 5." (Figure 8). All designs are made of a cloth made of recycled PET plastic bottles that can be folded into a completely regular and aesthetic plane geometry. This kind of resource-saving cutting method can also become a thinking reference for sustainable clothing design.



Figure 8. Brand "132 5."



Figure 9. A hang tag made of recycled paper

2.3.3. Personalized Customization

Personalized customization is a popular trend in the clothing industry in recent years. By tailoring according to the specific needs and preferences of consumers, it can not only

meet consumers pursuit of uniqueness and personalization, but also reduce inventory and waste, and realize the effective use of resources. In recent years, more and more clothing brands have begun to provide personalized customization services. For example, Weihai Dishang Group uses AI technology combined with 3D modeling to design styles and make virtual samples for customer orders. Using artificial intelligence technology combined with massive clothing database resources, to generate new styles, and build a vertical ecological supply chain platform for textile and clothing. This personalized and customized production mode not only improves the production efficiency and consumer satisfaction, but also promotes the development of clothing design to a more diversified and personalized direction.

2.3.4. Sustainability of Accessories and Packaging

In order to ensure the environmental friendliness of products and the effective use of resources, the design process of renewable, recyclable or biodegradable materials to make clothing accessories, such as the use of plant fiber buttons and zippers, and paper or biodegradable plastic labels, so as to reduce the dependence on non-environmentally friendly materials such as traditional plastics. At the same time, in terms of packaging design, the packaging style should be consistent with the design concept and echo each other, and more attempts can be made in its material. For example, the packaging and tag of designer brand PCYCL use soybean ink as printing raw material (as shown in Figure 9). Biodegradable delivery bags when delivered to customers to practice the concept of sustainable design and reduce the impact on the environment.

3. Conclusion

After the above research we found that the core of sustainable design thinking is the balance between aesthetics, function and environmental protection, through a wear design, classic permanent design, old fabric upgrade method to extend the life of clothing, using durable, biodegradable, recyclable and biological based materials to reduce the burden on the environment, at the same time using sustainable technology, zero waste cutting technology and packaging sustainability to optimize the production process. In addition, the introduction of AIGC technology provides new tools for design, improves efficiency and stimulates creativity. In the future, sustainable design will be in the clothing industry depth fusion and popularization, with technological innovation such as intelligent textile materials, 3D printing and the application of block chain traceability system, cross-border cooperation and sharing will become the norm, about sustainable fashion education and communication will continue to strengthen, sustainable fashion will become the normal consumption trend, promote the fashion industry in the direction of more green, healthy and sustainable development.

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