

# Research on the Development Trend of Green Design in the Post-epidemic Era

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## ABSTRACT

In recent years, the concept of green design research has become mature and developed steadily. However, due to the arrival of the post-epidemic era, medical waste has grown exponentially, and a large amount of garbage has flowed into the natural ecological environment. These medical wastes have caused serious damage to the current natural ecological environment, breaking the balanced green ecological model of normal development. The original green design concepts and principles are not enough to protect the existing natural environment. It is necessary to carry out a longitudinal study on the development trend of green design in the post-epidemic era and introduce new methods and concepts to expand the dimensions of green design, so as to construct green design research programs and ecological environmental protection strategies in the post-epidemic era, and thus putting forward the principles of green design in the post-epidemic era. This paper aims to protect the natural ecological environment, combined with the service-oriented design concept, systematically excavates, sorts out, and integrates the green design concepts and principles in the post-epidemic era, so as to better protect and improve the natural ecological environment.

**Keywords:** *the post-epidemic era; green design; ecological environment protection; service design*

## 1. INTRODUCTION

At the beginning of 2020, the novel coronavirus pneumonia (COVID-19) broke out on a large scale around the world. After months of hard work by medical staff and people across the country, the domestic epidemic has been effectively controlled. With the progress of medical research, China has entered the post-epidemic era<sup>[1]</sup>. Green design research is usually based on the premise of reducing the impact of environmental factors, and is carried out from the perspectives of green design, ecological design and sustainable design. However, due to the arrival of the post-epidemic era, medical waste has grown exponentially, and a large amount of waste has flowed into the natural ecological environment. It breaks the balanced green ecological model of normal development, the original green design principles are not enough to protect the existing natural environment. Therefore, in the context of my country's entry into the post-epidemic era, green design concepts and methods need to be sorted out and integrated in order to better protect and improve the natural ecological environment.

## 2. THE POST-EPIDEMIC ERA

With the advent of the post-epidemic era, medical waste have grown exponentially. According to the World Health Organization, the average daily consumption of masks in the world can reach up to several billion pieces, which is equivalent to 12,000 masks being used per second. The journal Oceanographic notes that indicators of single-use plastic products are growing catastrophically around the world as they are used everywhere to fight the COVID-19 pandemic<sup>[2]</sup>. And instead of being recycled, this huge amount of medical waste ends up in garbage dumps, flows into rivers and oceans, and fills the habitats of fauna and flora. According to a report by the World Wildlife Fund (WWF), even if only 1% of masks are mishandled, 10 million masks will pollute the environment every month. The plastic waste and medical waste caused by the epidemic need to be addressed and dealt with urgently<sup>[3]</sup>. Figure 1 shows a complete N95 mask dissected from a penguin corpse found on the coast of Brazil by zoologists in September 2020. Figure 2 shows a macaque biting a discarded disposable protective mask on a mountain outside Kuala Lumpur, Malaysia.



**Figure 1** A complete N95 mask was dissected from a penguin carcass.



**Figure 2** A macaque biting a discarded mask

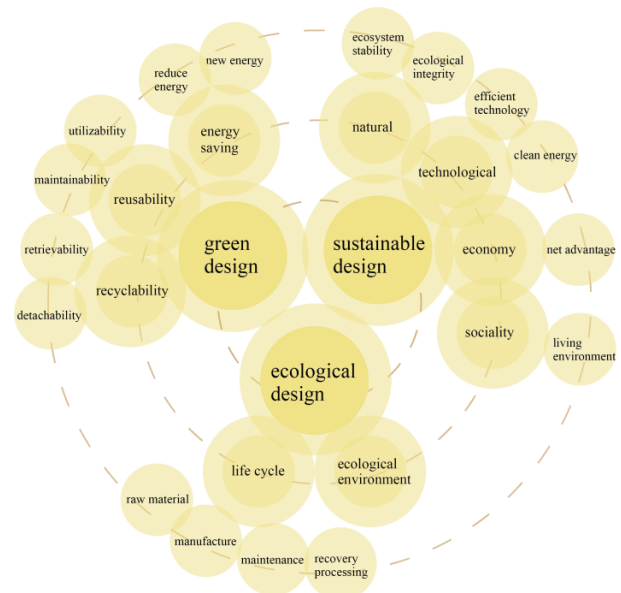
The waste generated during the epidemic has caused huge damage to the environment, and the post-epidemic era is facing even more serious problems. For a period of time after the epidemic, due to people's deep awareness of protection during the epidemic and the possibility of the epidemic coming again, there is still a high demand for disposable protective products. This supply and demand situation means that a large amount of medical waste will be generated. It is difficult to recycle and dispose of, and improper disposal will cause great damage to the natural ecological environment. Environmental protection of natural ecology is imminent.

### 3. GREEN DESIGN IN THE POST-EPIDEMIC ERA

#### 3.1 Formation and Development of Green Design Concept

Green design is based on the premise of reducing the impact of ecological and environmental factors, meeting the needs of various functions and development cycles of products, optimizing relevant factors in design and development, and taking resources and environmental performance as the core elements of the design concept<sup>[4]</sup>. Green design began in the 1980s, and its original concept was formed from human concerns about the natural ecological environment and limited resources. In recent years, the theoretical principles of green design and the scope of design content have been continuously

expanded. According to the expanded design content, it can be summarized into three development stages, as shown in Figure 3.



**Figure 3** Development of green design concepts

The first stage is the green design stage. The research in this stage is mainly carried out around the green design ontology, forming a standardized "3R" design principle, namely reducing energy and material consumption, increasing the recyclability of products and increasing the possibility of product reuse. In recent years, there are a large number of scholars who have studied and supplemented and extended the design principles of this stage horizontally. By combining the "degradable", to form a new "3R1D" design principle, and by adding the "Recover" to form a new "4R" design principle<sup>[5]</sup>. Although the design concept at this stage mainly revolves around the level of "post-intervention" to the environment, the research on its ontology is the purpose of green design, and subsequent researches related to green design are also formed on the basis of this concept. For the first time, human beings have incorporated environmental issues into the design category, which has greatly enhanced the social value and attention of the design discipline.

The second stage is the ecological design stage, which is the vertical expansion of the green design process and the whole process, and its research results include "life cycle design" and "ecological environment design". Among them, the complete life cycle should include the raw material processing, manufacturing, use and maintenance, recycling and other links of the product, and these specific links should cover the life cycle process of the product from design to production, to commercialization, and to demise<sup>[6]</sup>. The research in the ecological design stage no longer emphasizes the optimization of the design results, but focuses on the ecological and environmental factors in each period of

the green design, and requires the product to reduce the impact on the environment throughout the life cycle, and finally form a complete closed loop ecosystem.

The third stage is the sustainable design stage. Sustainable design is born out of the concept of green design and ecological design. It requires the harmonious development of people and the environment while expanding the sustainable dimension, and takes into account the natural, technological and economic attributes of sustainable design in a balanced manner. Taking the sustainable design of the environment as the starting point, to achieve the sustainable development of society, to ensure that the capabilities and resources needed by future generations are not damaged, and to meet the actual needs of contemporary people<sup>[7]</sup>. The natural attribute in the concept of sustainable design is to achieve an optimal ecosystem through the protection, restoration, improvement and planning of the natural ecological environment, which can exist in a form that ensures the integrity and diversity of the ecosystem and long-term stability. The technological attributes are reflected in the pursuit of clean energy and high-efficiency technologies to replace traditional energy, materials, processes and technologies in order to reduce the consumption of natural resources. Economic attributes are those that maximize the net benefits of economic development while maintaining the quality of natural resources and the services they provide. The social attribute is to improve the living environment of human beings through the harmonious coexistence of man and nature without exceeding the capacity of maintaining the ecological system.

### 3.2 The development trend of green design in the post-epidemic era

The epidemic era has impacted the natural ecological environment, breaking the original ecological environment balance. The natural environment needs to bear more domestic waste and medical waste from the

epidemic period. It is necessary to conduct longitudinal research on the development trend of green design in the post-epidemic era and introduce new methods and concepts to expand the dimension of green design, so as to construct a design scheme for ecological environmental protection in the post-epidemic era<sup>[8]</sup>. On the one hand, the development of green design in the post-epidemic era should rely on the overall development law of green design, ecological design and sustainable design, and on the other hand, it has the characteristics of a special era and the development trend derived from the background of the era.

In recent years, the development of green design tends to be more service-oriented. It is not limited to pure material product design, but reconstructs corresponding design solutions by integrating material products and their immaterial services. Reduce the consumption of resources and the negative impact on the environment<sup>[9]</sup>. Service design emphasizes that all touch points should be covered or involved in the process. Green design emphasizes that resources and environment are the core in the process. The concept of green design as a service is equivalent to the horizontal diffusion and optimization of relevant factors in the product life cycle. The two form complementary advantages. Introducing the service-oriented concept into green design can find the blind spots of products or systems in the green design process from the perspective of the whole process, and judge whether the design is truly green<sup>[10]</sup>. The development of green design in the post-epidemic era is shown in Figure 4, which will show the following aspects: The development trajectory of green design is linear, with the reduction of resource consumption and environmental protection as the core, focusing on the special background needs of the post-epidemic era, combined with the service-oriented design concept, and finally forming a combination of the background of the post-epidemic era, the traditional green design development model and the The development trend of the combination of service design concepts.

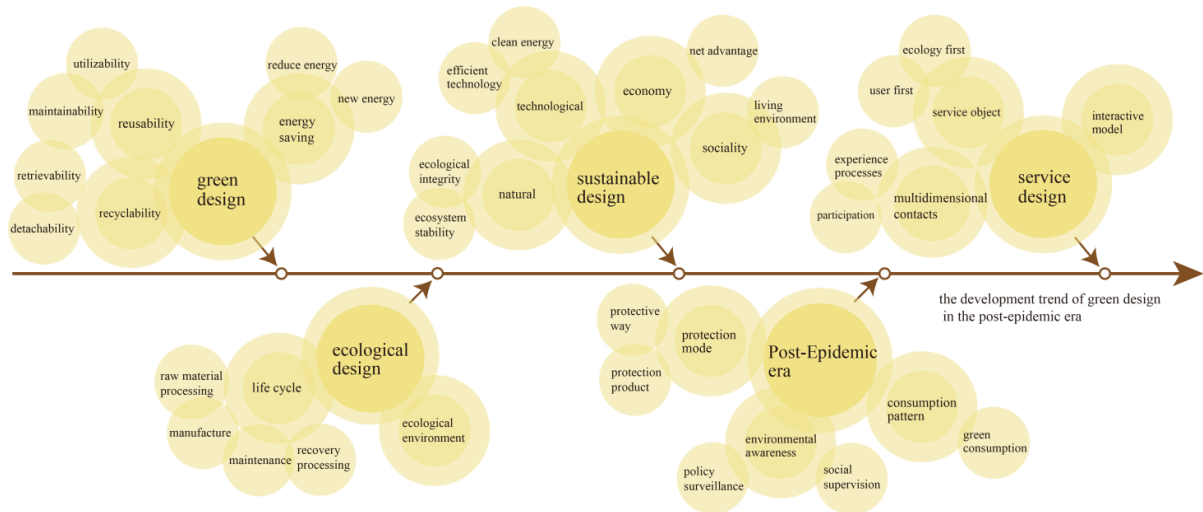


Figure 4 The development trend of green design in the post-epidemic era

#### **4. GREEN DESIGN PRINCIPLES IN THE POST-PANDEMIC ERA**

Based on the above theoretical research and case analysis, this paper summarizes the design principles that green design in the post-epidemic era needs to follow. These design principles adhere to the concepts of green design, ecological environment design and sustainable design, combined with the characteristics of the special era and its era. The development trend derived from the background also integrates the results of actual policies and measures. Afterwards, these design principles need to be revised according to actual policies and background conditions in use, and are continuously improved in design research and practice.

**Principles of circular and sustainable design:** based on the principles of circular and sustainable design, it is required to fully consider the possibility of recycling product parts and materials when designing, including the size of recycling value, recycling methods, and recycling processes in order to achieve the full and effective use of parts and material resources and energy. Product circularity is the result of product sustainability, and sustainable product design improvements can better achieve circularity within its life cycle. Through green design, the natural ecology and society can achieve a harmonious balance, so that the products can not only meet the needs of the society, but also minimize the damage to the natural ecology and human ecological environment, so as to ensure a benign and recyclable system cycle. In the post-epidemic era, people's awareness of protection has increased, the demand for disposable products has increased, and recycling and sustainability are less considered in design. Based on the concept of circular design, it is necessary to re-establish the concept of sustainability for users, improve products and optimize user behavior through circular design.

**Service-oriented design principle:** if green design cannot meet certain needs of users, but only produces a low-value product in a cycle, it will lose the significance of its natural ecological cycle and sustainable concept. Service orientation includes all-round design elements in the green design process, such as design objects and their stakeholders, demand directions of design objects, multi-dimensional behavior awareness, and interaction. The principle of service-oriented design is the core principle of green design in the post-epidemic era. Considering the principle of service-oriented design in the green design process can ensure that the products we design must be valuable and meaningful.

**Systematic design principle:** the core concept of the systematic design principle is to comprehensively consider the designed object system and the environment surrounding the object system from the perspective of the complete product life cycle, regard the system as an organic whole. The principle of systematic design

requires systematic inductive design and sorting out of the designed products or systems. In a complete ecological design, innovations aimed at a single product or independent technology should be avoided, and design research should be carried out from a system perspective to ensure a benign system.

**Principle of zero-touch interaction design:** the principle of interaction design is to solve design problems from a goal-oriented perspective. The goal-orientation of green design in the post-epidemic era is to ensure that the natural environment is not affected by the chain effect of the epidemic, and that the natural ecological environment can still be a benign state exists, During the epidemic period, people's daily behavior has tremendous changes. In the post-epidemic era, this behavioral awareness will be retained and continued to a certain extent. The interactive behavior realized through touch will be affected by people's formation of protective awareness during the epidemic period, which is difficult to achieve. Applying the principle of zero-touch interaction design to green design can improve the feasibility of green design and the necessity of intelligent interaction design. Considering the principle of zero-touch interaction in the development process of intelligent protection products can improve the acceptance and recognition of products.

**Design principle of relative independence:** the principle of relative independence is a design principle entirely generated by the changes in people's behavior in the post-epidemic era. Before the epidemic era, the concept of sharing economy was prevalent in explosive development. As one of the important trends of future social and economic development, its economic potential and development speed should have maintained a good trend. However, after the outbreak of the epidemic, people's awareness of protection has increased, and their exclusivity and independence of their products and behaviors have also increased. When self-preservation is triggered, the sharing behavior stops its normal development. The relative in the relative independence is relative to the sharing behavior. The green design in the post-epidemic era requires the steady restoration of the sharing concept without causing the recurrence of the epidemic. The principle of relative independence can save social resources on the premise of respecting the independence of users.

**Modular design principle:** the modular design principle is to divide the design main body into various subsystems, and extract the same elements of each subsystem to form a new system. Considering the modular design principle in green design, the design subject can satisfy both functional and environmental attributes, and solve the contradiction between product design and manufacturing cycle and production cost. On the one hand, it can shorten the product development and manufacturing cycle, improve product quality and use efficiency, and on the other hand, it can reduce the

adverse impact on the environment and facilitate product reuse, maintenance and disassembly, recycling and design improvement. In the development or optimization and improvement of disposable protective products, if the principle of modular design can be followed, the main design functional elements are extracted as the general design modules of disposable protective products, and the corresponding products are designed according to the specific use environment of the product, which will improve the quality of product design and product application efficiency.

## 5. CONCLUSION

In the post-epidemic era, medical waste has grown exponentially, and a large amount of garbage has flowed into the natural ecological environment, breaking the green ecological balance. We need to expand the concept of green design and form the development trend of green design in the post-epidemic era. Firstly, the development of green design in the post-epidemic era needs to adhere to its ecological environment design and sustainable design concepts, Secondly, expanding the green design concept and following the principles of circular and sustainable design. Then it is necessary to introduce a service-oriented design concept, combine the design methods in service design, and comply with service-oriented principles and systematic design principles; At last, it is necessary to comply with its special requirements in the context of the post-epidemic era. This paper aims to protect the natural ecological environment, combined with the service-oriented design method, systematically excavates, sorts out, and integrates new green design concepts and principles. The green design in the post-epidemic era in this paper is only the beginning. In the future, with the research of a large number of scholars and the in-depth intervention of various optimization methods, a series of discussions on its methods and principles will be generated, and eventually a systematic post-epidemic era will be formed. Green design concept system and ecological environment protection paradigm.

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