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Research on Eco-design of Express Packaging Based on System Thinking

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Abstract. The development of online shopping has boosted express delivery market, and it has caused heavy burdens to environment. The most serious problem is the waste of resources and environmental pollution because of excessive packaging waste. This paper uses the system thinking and ecological design method to take the internal and external systems of the express packaging as a whole research object . Through dialectical analysis and high integration， the elements of the internal and external systems are coordinated with each other, and then the optimization of express packaging is realized. This paper achieves the real ecological express packaging design by studying the ecological express packaging system and considering various factors inside and outside the express packaging system.

1. Introduction

Nowadays, the development of online shopping has boosted the development of the express delivery market, but also caused heavy environmental burdens. The most serious problem is the waste of resources and environmental pollution because of excessive packaging waste. [1] Through the research of express packaging, this paper explores the problems of express packaging with systematic thinking and seeks solutions to realize the ecologicalization of express packaging, fully embodying the strategy of mutual coordination and sustainable development of environmental protection and economic development. Most of existing researches are focusing on individual fields of express logistics and transportation such as boxes packaging and transportation.Therefore,they are not multi-angled analyses. The trend of ecological packaging is irreversible,and complicated as the ecological packaging is, the use and recycling are essential. Only by considering both internal and external factors of the express packaging system can we achieve a true ecological cycle.

2. Research background

The development of online shopping has boosted the development of the express delivery market. According to the statistics of the State Post Bureau, the volume of China's express delivery business is increasing at an alarming rate from 2013 to 2017, from 9.19 billion to 40 billion. In just five years, this figure has actually quadrupled. The prosperity of the courier industry has also led to a heavy environmental burden while promoting economic development rapidly. One of the most critical problems is the waste of resources. As the consumption of products increases, the scale of logistics packaging for commodity packaging boxes is also growing, and due to a large number of disposable packages and excessive packaging, it will inevitably consume too much natural resources.

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Table 1. Traditional design versus system design

Traditional product design	Eco-product design based on system thinking
Take the product as an individual part, considering aspects like profit, function, aesthetics,environmental conditions and efficiency, corporate image and overall quality separately.	Consider the relationship between products and the environment in the whole life cycle, and decompose and combine different factors of design to realize the real eco-express packaging design.

3. Internal and external factors of product design based on system thinking

In the product design based on system thinking, the designer is required to consider not only the requirements of the basic elements such as the shape and function of the single object, but also effects on environment based on system thinking. Product eco-design refers to the integration of environmental factors into product design, taking into account the environmental impact of the entire life cycle of the product during the design phase, thereby helping the decision-making direction of the design, and then minimizing the negative impact on environment by improving the design idea.

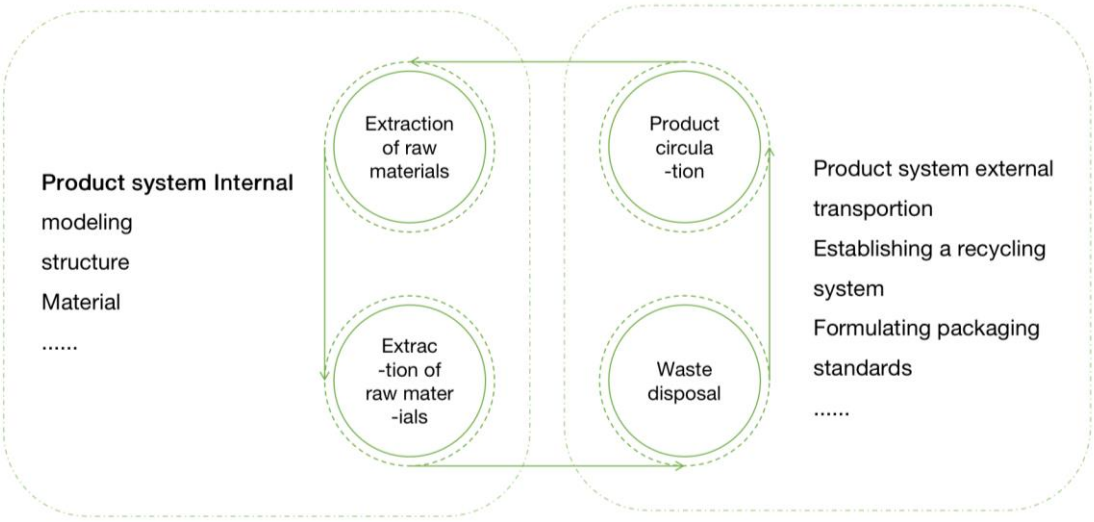


Figure 1. system flowchart.

3.1 Product internal system

In the product life cycle, the extraction of raw materials to the manufacture of products is the formation process of the product, thus forms the internal system of the product. The product internal system consists of relatively stable elements and structures and has relatively independent functions. Elements constitute the internal system of the product. The structure is the method and order in which several elements are related to each other and interact. The purpose of connecting the product elements through the organic structure is the product function. The realization of the product function is the combination of internal product system and the external environment. [5] By the process of combination, the element and structure of the product transforms into a deep structure to achieve product functions.

3.2 Product External System

In the product life cycle, from product circulation to waste disposal, energy regeneration and reuse are the realization of product function, forming an external system of products. There are various factors affecting the external system of the product, such as the market environment, the state of the consumer (including age, gender, consumption concept, cultural taste, custom, etc.) and national policies and

regulations, etc., which may functionally affect the product. Moreover, the realization of function usually means the interaction between products and people with different lifestyles. Consumers don`t understand and use the same product in the same way in different situations, which makes the function of the product complicated and diverse.

4. The ecological express package internal system based on system thinking

4.1 Ecological packaging

Ecological packaging should be a packaging that is harmless to the natural environment and human health, which can be reused and can promote the sustainable development of the national economy. [6] That is to say, the whole process of packaging products including raw material selection, product manufacturing, use, recycling and disposal should meet the requirements of ecological environmental protection. For instance, saving resources and energy, reducing volume, even avoiding waste generation, recycling, being able to incinerate or degrade.

4.1.1 Packaging modularization. The modularization of the package determines the basic dimensions of the package.The smallest packaging unit is a carton. A number of cartons are placed on the pallet, and then several pallets are finally placed in containers or vans for long distance transport. In order to reduce the logistics cost, it is a very simple and intuitive way to maximize the product quantity in the packaging. If the modular packaging design is adopted, the packaging efficiency will improve, thereby the logistics cost will be reduced .

4.1.2 Large-scale and containerized packaging. It is conducive to the logistics system in the process of loading, unloading, relocation, storage, transportation, etc., making the operation in these links more effective, and it is good for reducing unit packaging, saving packaging materials and packaging costs, and protecting the cargo. Those advantages can be achieved by various methods such as containers,container bags,trays and others. [8]

*4.1.3 Packaging reuse and waste disposal.*Using general-purpose packaging, and no special arrangement for returning to use; using reusable packaging, which can be used many times,such as beverage and beer bottles, etc.; realizing material-step-utilization,which means the material can be used for other purposes after packaging process; recycling the packaging material and then convert it to produce other objects.

4.1.4 Exploiting new packaging materials and packaging equipment. It is a new trend that making the packaging multi-function to realize various functions of packaging with less material. [10]

4.2 Ecological material

On the premise that the packaged product meets its design function, the less the material and energy consumption in the packaging manufacturing and using process, the better the impact on the environment. Environmental impacts include: effects on air, water consumption and pollution to water, and impacts on soil, heat and energy consumption in manufacturing and use, possibilities of waste reuse and the service life of packaging material, etc. [11]

Table 2. Ecological packaging and ecological materials

Ecological packaging	**Ecological material**
Packaging modularization.	On the premise that the packaged product meets its design function, the less the material and energy consumption in the process of packaging manufacturing and use, the better the impact on the environment.
Large-scale and containerized packaging	
Packaging reuse and waste disposal	
Exploiting new packaging materials and packaging equipment.	

5. Eco-Express Packaging External System Based on System Thinking

5.1 Ecological transport

Ecological logistics aims to reduce pollution and reduce resource consumption. It uses advanced logistics technology to plan and implement logistics activities such as transportation, storage, packaging, and loading unloading, circulation processing. [12] While mitigating the harm of logistics to the environment in the logistics process, the purification of the logistics environment is realized, and the logistics resources are fully utilized.

5.2 Establishing a recycling system

Reusing packaging material and establishing a recycling system. It is recommended that government takes effective measures to speed up the classification and recycling of express packaging. [13] Government can cooperate with large-scale e-commerce companies such as Suning Tesco, Jingdong, and some express delivery enterprises to implement the express package recycling program, and establish pilot packaging callback and recycling center at cargo picking up store or logistical distribution center for packaging material`s classified recycling. [13]

5.3 Formulating express packaging standards

The government and express industry associations should become the makers of express packaging standardization. In terms of packaging size, mainly corrugated boxes and packaging bags, the government and associations should formulate a set of rules that meet the needs of the express delivery industry based on the actual situation of express packaging.

6. Conclusions

The eco-design of courier packaging based on system thinking proposed in this paper no longer treats courier packaging parts as a separate link, but from a perspective of eco-friendly it takes product system as a goal to achieve an overall optimal system through scientific decomposition, modular design and combination optimization.

This paper discusses the implementation of ecological design based on system thinking through practical cases, and verifies the feasibility of the method. Through analysis, it is proved that the technology and art, function and form, economy and efficiency ,macro and micro all can be balanced , by applying the ecological and systematic design method and considering the relationship between product and environment in the whole life cycle and also by decomposing and combining different design factors. Therefore, the products involved answer the requirements of sustainable development better than common ones.

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