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# The Application and Reflection of Cradle to Cradle in Industrial Design

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**Abstract:** In the development of the past few centuries, global design and production have adopted methods of using new resources and discarding old resources. However, this approach has led to crises of global pollution, ecosystem destruction, and scarcity of natural resources. Therefore, this article delves into the concept, application methods, and role of Cradle to Cradle, verifying its importance in industrial design products. The specific application of Cradle to Cradle in industrial design was demonstrated through practical cases, and its actual effect in the industrial design process was verified. The effectiveness of Cradle to Cradle in industrial design has been verified through practical cases, demonstrating the feasibility and sustainability of this concept. Finally, it is concluded that integrating the concept of "cradle to cradle" into industrial design can effectively promote sustainable environmental development, promote the recycling and reuse of resources, and create a better living environment for people. At the same time, this design method also brings economic benefits and market competitiveness to enterprises.

**Keywords:** Industrial design; Sustainable development; Sustainable industrial design; “Cradle to Cradle”.

## 1. Introduction

In this consumer centric era, the products we design have exhausted a lot of resources, and businesses may profit greatly, but the entire natural environment has been severely affected as a result. Although the country and government have issued a series of policies and regulations, the mitigation effect on current environmental pollution and other issues is not significant. In order to address the issues brought about by these developments, theories such as green design, ecological design, and low-carbon design have been introduced to support industrial design. However, during the implementation process, it was found that these theories mainly focus on environmental protection, but ignore social and human needs. Subsequently, the scratch to scratch theory was proposed, which not only focuses on environmental issues from a green and ecological perspective, but also values human and social factors. Therefore, this article conducts in-depth research on the concept, application methods, and impact of the Cradle to Cradle theory through practical case analysis, confirming its importance in industrial product design. In this article, I will use the method of analyzing practical cases to discuss the application and thinking of Cradle to Cradle in industrial design, as well as its practical impact on humans, the environment, and society.

## 2. Organization of the Text

### 2.1. The transformation of development models

#### 2.1.1. The development model "cradle to grave"

Nowadays, standardized and intensive production methods have accelerated the speed of commodity production and improved people's living standards. This industrial production method only focuses on the production of goods and delivers them to consumers in a fast manner, without paying attention to the comprehensive factors of various aspects across the entire system—The diversity of the entire ecosystem, the interrelationships and impacts between various aspects. And at the end of the industrial system, the effective value of product materials is not reused. This is a ' "cradle to grave" mode.For the engineer who has always taken—indeed, has been trained his or her entire life to take—a traditional, linear, cradle-to-grave approach, focusing on one- size-fits-all tools and systems, and who expects to use materials and chemicals and energy as he or she has always done, the shift to new models and more diverse input can be unsettling [1].

#### 2.1.2. The development model "cradle to cradle"

Based on these situations, some designers have made changes and started designing sustainable products. Sustainability is often understood as a strategy of doing more with less” or “reducing the human footprint” to minimize troubling symptoms of environmental decline [2]. Although some designers may have incorporated sustainable development into their designs, it only solves the problem rather than the root cause. We should adopt a new concept - the "Cradle to Cradle" design concept - with a focus on creating products that can be completely reused or recycled at the end of their lifespan without generating any waste, fully addressing the drawbacks of "cradle to grave" and sustainable design. So designers should advocate extending the product's lifecycle. Products, packaging, and systems have been designed with no waste and are considered for future upgrades and reuse, becoming a recyclable "cradle to cradle" model.


**Figure 1.** A comparison of three different economies, the right choice of modern designers is the "cradle to cradle" economy.

The design that adopts the concept of "cradle to cradle" not only brings tremendous changes to the world environment and creates a happy and beautiful life for people, but also brings unexpected economic benefits to enterprises while striving for the world.

## 2.2. The Application of "Cradle to Cradle" in Industrial Design

### 2.2.1. The biological cycle of "Cradle to Cradle"

Dgdiapers fully conforms to the design concept of the biological cycle from "cradle to cradle" and creates a happy and beautiful life for people

A baby uses approximately 8000 before undergoing bedpan training.What is the method of handling such a large quantity of diapers?At present, the main treatment methods for used diapers are burial, incineration, and random disposal. However, due to the insolubility of diapers in water and the difficulty in degrading their plastic components by around 30%, no matter which method is currently used, it may cause pollution to environmental factors such as the atmosphere, soil, and water bodies.

Beginning to turn away from substances that are widely recognized as harmful is the step most individuals and industries take first as they move toward eco-eflectiveness [3].Therefore, in order to stay away from waste plastics, gDiapers took action and set new goals, taking the first step towards achieving Eco-Effectiveness: manufacturing diapers free of suspicious toxins for safe composting after use.

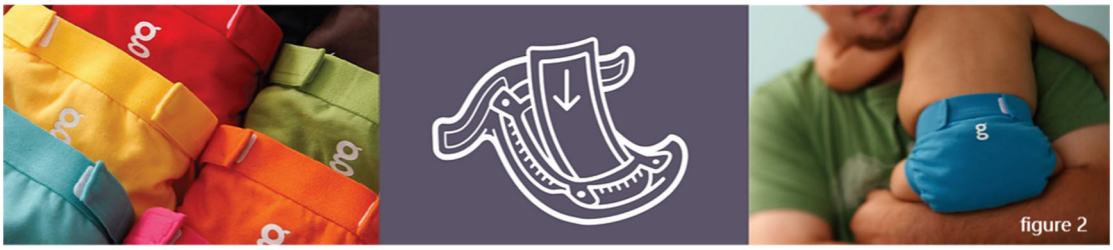


**Figure 2.** The color, structure, and usage scenarios of gDiapers.

The redesign of diapers by gDiapers reflects the company's commitment to social fairness. Previously, plastic diapers had cushions, sponges, fibers, and other components inside that could absorb moisture, while the outer plastic film was waterproof and had poor breathability. If a child uses low-quality diapers, it may lead to diaper rash and eczema. The new diaper designed by gDiapers uses comfortable cotton and breathable nylon. Babies can enjoy a comfortable experience like adults, providing them with a comfortable and happy environment. Due to the various shapes and sizes of babies, diapers should also be available. Therefore, gDiapers has designed five sizes of gPants: the most comfortable and effective diapers, suitable for babies' constantly changing shapes. And there is no odor, no dirty smell, and less laundry than diapers, which means parents are happy.The issue of respect is at the heart of eco-effective design, and although it is a difficult quality to quantify, it is manifested on a number of different levels, some of which may be readily apparent to the designer in search of material: respect for those who make the product, for the communities near where it is made, for those who handle and transport it, and ultimately for the customer [4]. Respect babies and parents who use diapers, add joy to their lives, and create a better life which are completely in line with the second step of Eco-Effectiveness—Follow informed personal preferences.

gDiapers fully adheres to the principle of keeping materials in a biological closed-loop and detachable. More than 75% of diaper pads are cellulose based, resulting in some disposable and reusable bio based diapers. After using disposable diapers, they can be easily disassembled, composted and decomposed in household composting, increasing soil organic matter, forming a regenerated natural system, and once again providing nutrients for the cellulose base of biological diapers.This not only prevents plastic pollution from the source, but also collects diapers and composts them into nutrient rich soil, thereby supplementing the Earth. We call it gCycle. And diapers use renewable resources—cellulose resources can not only participate in the cycle, but also replace fossil energy, reduce carbon dioxide emissions from landfills, and strive to reduce carbon emissions.

gDiapers has not stopped and is also working towards the final step of Eco-Effectiveness—recovery. gDiapers hope not only to design a diaper, but also to make everything in the diaper nutritious for nature or industry. After adopting the principle of "cradle to cradle", the design will not only change the world's ecological environment and resource depletion, but also create a happy life for people.

### 2.2.2. The technological cycle of "Cradle to Cradle"

The design concept of "cradle to cradle" includes not only biological cycles but also technological cycles. Apple is a great example, and adopting this concept not only brings changes to the Earth’s environment, but also brings huge economic benefits to Apple.

At present, the components required for smart phone chips and motherboards are expensive metals, and the energy and money consumed by mining these metal resources cannot be underestimated, and they also generate a large amount of carbon emissions. Once these resources are extracted, they will embark on the path to the grave. In addition to production, improper recycling can also increase the environmental burden. The recycling rate of smartphones is only 1% -2%, so what about the remaining phones? Most of them have already been landfilled and incinerated, which not only pollutes water sources and soil with heavy metals, but also produces harmful substances and pollutes the atmosphere.

Therefore, at this moment, Apple has taken the first step of Eco-Effectiveness, decided to change the production composition and recycling method of mobile phones, rapidly promote the goal of "closed-loop manufacturer" and "upcycling", and achieve carbon neutrality by 2030. At that time, Apple will not only achieve the recycling and reuse of raw materials, contribute to the ecological environment, but also gain new market competitiveness, expand the market, and achieve economic benefits.

Production:

It would not do to select unattractive things just because

they had more environmental authority—an ugly facility was not what they were hired to build [5]. Therefore, Apple has taken the second step towards Eco-Effectiveness design while ensuring the aesthetics and fashion of its devices—Be as sure as you can that a product or substance does not contain or support substances and practices that are blatantly harmful to human and environmental health [6]. For example,In order to make the device more inclined towards ecological intelligence, Apple machines do not use a series of measures such as flame retardants containing harmful mercury, coatings, and bromination. Next, Apple developed specifications for inherently hazardous substances based on the third step of Eco-Effectiveness design, and conducted extensive material characterization through testing to demonstrate compliance with requirements. Apple places great emphasis on details and research when selecting materials for its products to ensure the safe production, use, and disposal of Apple products by workers, customers, and recyclers.

In addition to its efforts in raw material safety, Apple is committed to completely decoupling from the mining industry due to the significant energy consumption involved in mining raw materials. Apple has started the fourth step of improving Eco-Effectiveness—redesigning new materials instead of becoming less bad. For example, aluminum is one of the most widely used materials by Apple, serving as the "surface" of a series of Apple products. Apple announced the launch of a 100% recycled aluminum alloy for electronic product casings. This aluminum alloy can be recycled multiple times, not only maintaining its original quality, but also significantly reducing the carbon footprint of Apple products. And since 2015, Apple has helped manufacturing suppliers switch to renewable electricity produced from renewable energy projects such as solar and wind energy through supplier clean energy projects,in line with the principle of "cradle to cradle".By utilizing new materials, apples reduce their dependence on raw material extraction, transportation, and processing, save costs, shape the company's "green image", and improve economic efficiency.

Recycling:

More noteworthy is the recycling of apples. Apple adopts a dismantling design to create a circular supply chain, which only uses renewable resources or recycled materials to manufacture products. Apple's Material Recovery Lab in Texas, USA is conducting research to help use robots Daisy, Dave, and Taz to disassemble the iPhone and its components, recovering key materials such as gold, cobalt, tungsten, and rare earth elements. The collected materials will eventually return to the raw material market, and whether it's apples or others, they can use recycled materials to manufacture a new generation of products, forming a technological closed-loop and ultimately achieving an upcycling. In theory, if Apple could close the "closed-loop supply chain" tightly enough - to recycle and recycle its sold products - it could also reduce the impact of raw material price fluctuations.

However,Apple has not stopped there, it is still moving towards the "cradle". No matter what it does, Apple will carefully consider its impact on humans and the Earth. Continuously asking oneself how Apple's efforts can bring more positive forces to the world.So how can a design that adopts the C2C concept contribute to the company's profit goals? It can increase revenue by enhancing the company's image, save costs by using materials more effectively, recycling, energy and water, and reducing waste treatment costs, thereby contributing to the company's financial performance.

# 3. Summary

The concept of "cradle to cradle" is actually about putting quality first and ensuring that things are designed to be safe and healthy in the biological or technical cycle. This is about ensuring that things are designed to safely return to the soil or industry without mutual contamination. This is the first priority, because if we recycle toxic substances, the situation will be even worse. The design adopts the concept of "cradle to cradle", which not only solves the environmental impact of the aforementioned problems, but also promotes the formation of a prosperous and healthy world, creating a happy and beautiful life for people. This will also bring huge economic benefits to the enterprise, as there is no waste.

So I hope that designers will recognize not only the environmental impact of their designs over time but their social and ethical impacts too [7], and immerse themselves in "cradle to cradle", so that we can elegantly and with dignity share the present with the future to the world.

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