DEPARTMENT OF MECHATRONICS AND ROBOTICS

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Sustainable Development Assignment

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Abstract

This paper mainly introduces the sustainable development of ***bicycle saddle****. Meanwhile, we discuss the problems encountered in the process of sustainable development of bicycle saddle and finally give the solutions.*

First of all, we start from the introduction of the bicycle, introduced the types of bicycle saddle and ***design features****. At the same time, we also study the market situation of bicycle saddle and the* ***market occupancy*** *of each company. In the part of the sustainable development of the bicycle saddle, we introduce it from three angles: the* ***Economic sustainability****,* ***Environmental sustainability****,* ***Social sustainability****. Moreover, in the part of the Process Flow Diagram of Life Cycle, we draw a process of the* ***Cradle-to-Grave*** *and analyze it. In the next part, we draw the* ***Matrix of Life Cycle Stages*** *and give a* ***score*** *according to the degree of influence. In the Matrix section, we pay more attention to analyzing the influencing factors of Sustainable Development.*

Finally, we put forward the ***design opportunities****, we can replace the traditional non-recyclable materials with new materials to achieve the purpose of sustainable development. In this part, I also introduced* ***my patent****:* ***plastic bottle bicycle saddle****, hoping to provide a solution for the sustainable development of bicycle saddle.*

Catalogue

1.Product or Process Selected

1.1 The Development of Bicycle

With people's increasing pursuit of health, it has been widely accepted to ride a bike instead of driving a car for short trips. Bicycle, as a common means of travel, is a green and environmentally friendly tools of transportation.

The bicycle saddle on the market is mainly composed of **surface materials**, **filling and shock-absorbing materials**, **base plate** and **seat bow**. In addition to the function of transportation, people also regard bicycles as a kind of fitness equipment. Moreover, there are also derived "cyclists" who take bicycles as the main body to travel. At present, shared bikes are still widely accepted by young people and have a huge market prospect.

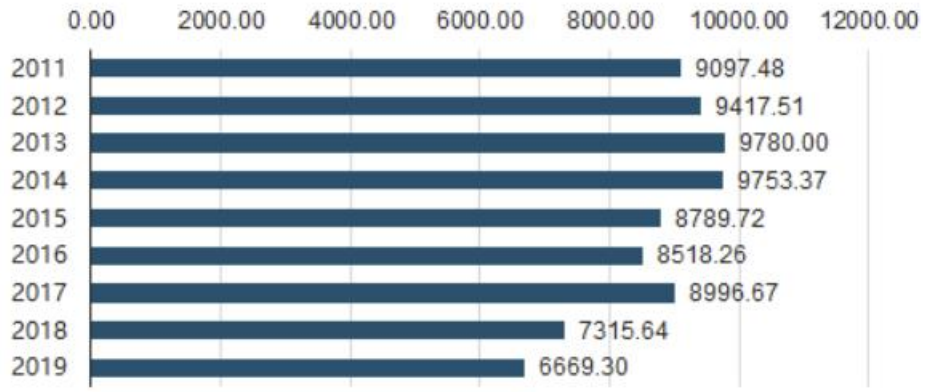

Figure 1: Bike production in China in 2011-2019(10,000 units) [1]

1.2 Sustainable Development of bicycle saddle

This time I choose a bike saddle, which is used to make users ride bikes conveniently. Because there are more and more bikes on the market, this phenomenon is bound to cause many problems. [1] For example, the packed structure inside a bicycle (Sponge) is difficult to recycle, which can cause **environmental** pollution. If we can recycle bike saddles for sustainable reuse, we can reduce some of these

economic costs. In addition, with the prevalence of shared bikes, how to deal with these overproduced bikes has become an important issue for **society**. Therefore, it is very necessary to discuss the sustainability of bicycle saddle. I will introduce the Sustainable Development of the bicycle saddle in detail below.

1.3 Article Overview

First, I will describe the Cradle-to-Grave process. Then, I will provide the Sustainability Matrix and give a score one by one based on the importance. Finally, I'll explain some better solutions, including **my patent** for a sustainable bike-saddle model: **Plastic bottle bicycle saddle**

2. Outline of the scope of product or process

2.1 Design features

As they are used in different areas, bicycle saddles are designed in various ways. However, in general, the bike saddles are mainly composed of four structures: Surface material, Filling and shock-absorbing materials, Base plate, and Saddle bow.

The functions and design characteristics of each part are as follows:

1.Surface material: **contact surface with hip**, influence function of air permeability and smoothness.

2. Filling and shock-absorbing materials: **expand the contact surface** between the hip and the seat cushion, and carry part of the vibration, bringing comfort.

3.Base plate: **support**s the filling material and weight, also plays a role in vibration relief

4.Seat bow: **carrying seat cushion**, also has the function of **vibration relief**.

Figure 2: The components of bicycle saddle

In general, the bicycle saddle should have the following design characteristics:

1.Light

2.Beautiful appearance

3.Air permeability, comfortable, convenient for long time cycling

4.Buffer, shock absorption

5.Support for better acceleration when riding

2.2 Marketing situations

With the development of society, China has become the world's largest manufacturer, consumer and exporter of bicycles. As a result, the demand for bike saddles is growing. Among them, the **market occupancy** of each major brand is as follows:

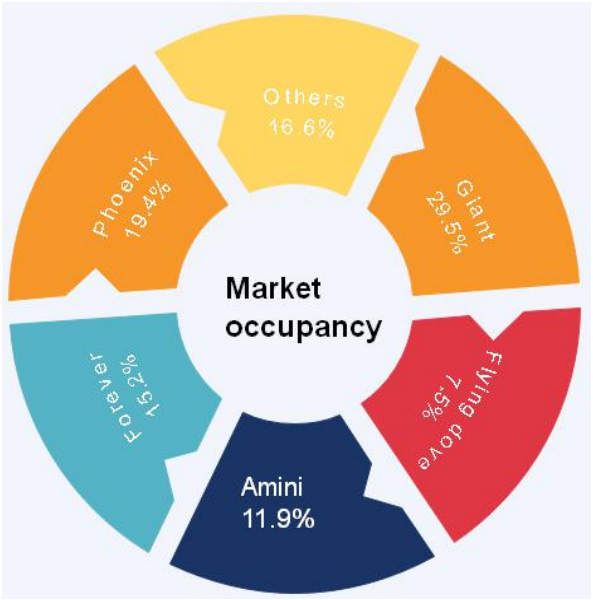

Figure 3：Market occupancy [3]

According to the demand, the bicycle saddle can be roughly divided into four kinds: Mountain cycling saddle, Road cycling saddle, soft saddle, Silicone saddle.

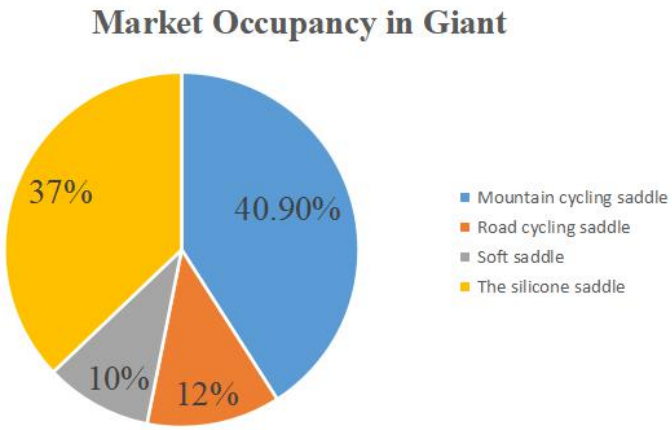

Figure 4:Market Occupancy

2.3 General sustainable issues

Since the materials used to make bicycle saddles are mainly rubber, steel and plastic, their waste products are difficult to recycle. Because the traditional bicycle saddle is still popular in the market, the sustainable value is very low. Sustainable issues mainly include the following aspects:

1.Most of the saddle filling materials are sponges and other unrecyclable soft fillers, which are very difficult to recycle under normal circumstances. Once it is discarded into the natural environment, it is **difficult to degrade** and will cause serious damage to the environment.

2.Due to the low recovery rate of steel in the market and the low metal composition of the bicycle saddle, the **cost of recycling is so high** that few people will recycle the metal of the bicycle saddle.

3.Due to the improvement of living standard, in most cases, once the bicycle saddle is damaged, people tend to consider **replacing it** with a new one, and few people will consider repair or recycling.

3. Framing of Product or System in a Sustainable Development Context

3.1 Sustainable Development

3.1.1 Economic sustainability

A bicycle saddle is an integral part of a bicycle. Since the production of bicycles is very large in China and even in the world. In addition, because the bicycle saddle is easy to have a breakdown, some consumers may leave a few bicycle saddles for spare, which will also increase the consumption of bicycle saddle, indirectly promoting the bicycle saddle industry sustainable development.

3.1.2 Environmental sustainability

For older bike saddles, most of them consist of sponges and other non-recyclable fillings, which are difficult to recycle. In addition, if the sponge waste is treated by combustion, the toxic gases will be produced by combustion, such as **carbon monoxide, hydrogen cyanide, formaldehyde** and so on. These harmful items will have a very bad impact on the environment and the human body. [4]

For the new bike saddles, most of them will use new environmental-friendly sponges: **Renewable Sponge.** Renewable Sponge is flexible, durable, non-deforming and odourless. The most important thing is that the renewable sponge is made from leftover materials which are used to make other sponges. Moreover, the leftover sponge is safe and qualified after the quality inspection. They are also easier to shape and more durable. [4] For us, renewable sponges can undoubtedly achieve better Sustainable Development.

3.1.3 Social sustainability

Due to the initiative of the world environment organization: we should try to reduce the use of non-recyclable disposable items, such as disposable plastic bags, straws and so on. If we use renewable and environmentally-friendly bicycle saddles in our life to meet the requirements of sustainable goals, it will undoubtedly get greater social support. People will also be more inclined to buy eco-friendly bike saddle.

3.2 The sustainability of bicycle saddle

The sustainability of bicycle saddle is mainly explained from the following aspects:

3.2.1 Depletion

Bicycle depletion occurs in the process of production and use, so the discussion on sustainability must involve the depletion. In the manufacture of bicycles, there is a loss of energy, including natural resources.

3.2.2 Cost

The production and fabrication of bike saddles require many resources. In a sustainable development system, we need to spend a certain amount of money to clean up the environmental damage in the manufacturing process. Similarly, in transportation, we also need natural resources like petroleum to drive, which is mainly dependent on the cost of gasoline and gas resources.

3.2.3 Energy usage

There is no doubt that bicycle saddles need to use energy in the production process. The machines that make bicycle saddles need electricity. In the same way, if an electric drive is needed during transportation, the power source will also be used.

3.2.4 Waste

In the manufacturing process, the completion of the product will be accompanied by certain accessories, which will lead to a large amount of waste. In addition, if the bike saddles are abandoned, the bike saddle itself will become a waste.

3.2.5 Carbon footprint

In the manufacturing of bicycle saddles, the steel and plastic factory uses electricity and other resources to make them. In the process of transportation, gasoline will be burned into C02 and other gases.

Table 1: The comparison with Traditional bicycle saddle and New bicycle saddle

	Traditional bicycle saddle	New bicycle saddle(Renewable sponge)
Cost(per m^2)	5$	10$
Lifetime(year)	1	2
Environmentally friendly?	No	Yes
Hazardous materials?	No	No

4.Process Flow Diagram of Life Cycle (Cradle to Grave)

4.1 Cradle-to-Grave Process

Waste generators are responsible for all hazardous waste they create from the moment it's generated to the ultimate disposal of that waste.[5]

4.2 Flow chart of Cradle-to-Grave Process

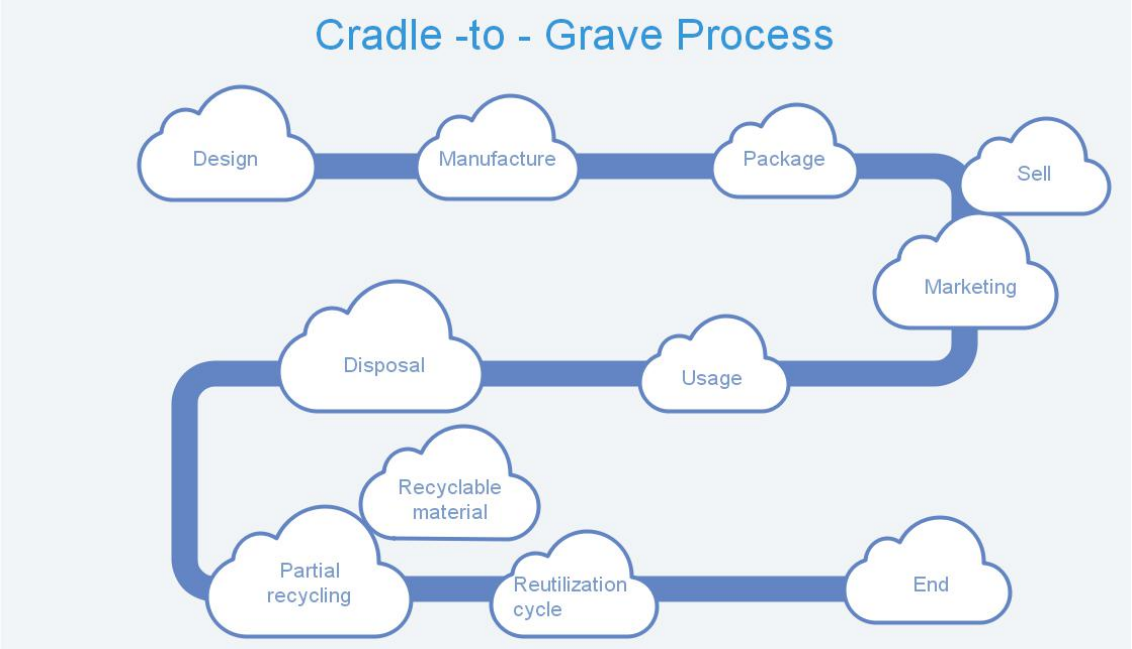

Figure 5: The Cradle-to-Grave Process

4.3 Stage introduction of Cradle-to-Grave Process

4.3.1 Design

Features: The bicycle saddle is required to meet these requirements:

Light, beautiful appearance, air permeability, comfortable

Components：

1.Surface material：leather

2. Filling and shock absorbing materials：Sponge

3.Base plate: plastic

4.Seat bow: Steel

4.3.2 Manufacture

For the surface contact material, we use the machine to produce the appropriate size; For the filling material, we need to cut the sponge to the right size; For Base

plate, we need to make moulds so that the factory can process them in large quantities; For the Seat Bow, it needs to be manufactured in a specialist steel manufacturing factory.

4.3.3 Package

Bicycle saddle packaging is mainly carried out in a specific factory, generally, we need to put the four parts together, fixed them by machine. This process is to ensure that each component will not be misplaced.

4.3.4 Marketing

Bicycle saddles are usually sold to customers along with the bikes, but a few are sold separately. For traditional bike saddle, it could not be used for a long time and easy to break down. However, a new saddle, such as the saddle made of regenerated sponges and silicone may make people more comfortable and be used longer. Because of the advantages, New saddles can be more favoured by consumers and the market prospect is very big.

4.3.4 Usage

The saddle is usually used to support the rider and make it easier for the rider to exert force; In addition, the saddle also needs to be breathable to make riders comfortable.

4.3.5 Disposal

Once the bike saddle is damaged, the normal way is to dispose of it, which may seriously pollute the environment. It's hard for nature to degrade the polymer material. If it's burned in the dump, all the toxic gases like S02 will be released from the bike saddle. Among them, the safest and most effective way is to give the abandoned bicycle saddle to let the manufacturer dispose of. The manufacturer can use the

abandoned materials to make a new bicycle saddle, which will be more environmentally friendly and sustainable.

4.3.6 Partial recycling and Secondary recycling

For some new bike saddles, parts of them can be completely recycled. For example, new materials such as silicon used in new bike saddles can be reused many times to achieve sustainable goals.

5.Matrix of Life Cycle Stages and Sustainable Development Impacts

When we designed the Matrix of Life Cycle Stages, we took into account the Depletion, Cost, Energy Usage, Waste, Carbon footprint and other factors. In the cycle of the bicycle saddle, we consider the factors of raw materials, production and manufacturing, transportation, usage disposal and recycling.

The designed Matrix is as follows:

Life cycle stages	Depletion	Cost	Energy Usage	Waste	Cabon footprint
Rawmaterials	Gasoline,Steel,Sponge	Crude oil / sponge Environmental recovery cost of rawmaterial collection	Energy expended in raw material collection	Scrap from raw collection	Electricity used in plastics factory and steel-making
Manufacture and package	Employee	Plastic is cheaper	Energy expended in raw material manufacture	Chemical waste in the process of manufacture and Packaging bags waste	Gas emission during production
Distribution	Truck,Ship,Airplane	Cost of vehicle in transportation	Energy of vehicle in motion		Burn fossil fuel
Use		Some people will buy substitutes			
Breakdown	Partial components	Maintenance cost		Scrap in maintenance	
Disposal				Emission of harmful gases during incineration	Electricity used in waste disposal
Secondary reuse		Cost of recycling			Energy is recycled

In Matrix of Life Cycle Stages, I take the recycling of bicycle saddle as a Life Cycle stage, too. Although the majority of bike saddles are burned instead of recycled. However, once we begin to recycle bike saddles, we can reduce the cost of re-manufacturing them and reduce the energy use.

In the part of raw materials, we need to take into account the cost of raw materials, including crude oil used to make plastics. Moreover, in the process of sustainable development, we also need to take into account the damage to the local environment caused by the exploitation of raw materials. Therefore, the cost of restoring the ecological environment should also be taken into account.

6. Scoring Matrix of Sustainable Development Impacts

In the Scoring Matrix, the principles of Scoring are as follows:

Number 0 = no effect

Number 5 = major effect

Negative number indicates an improvement

Next, we will score each item in the matrix

Life cycle stages	Depletion	Cost	Energy Usage	Waste	Cabon footprint
Raw materials	Gasoline,Steel,Sponge 5	Crude oil / sponge Environmental recovery cost of raw material collection 3	Energy expended in raw material collection 3	Scrap from raw collection 2	Electricity used in plastics factory and steel-making 2
Manufacture and package	Employee 2	Plastic is cheaper -1	Energy expended in raw material manufacture 2	Chemical waste in the process of manufacture and Packaging bags waste 4	Gas emission during production 3
Distribution	Truck,Ship,Airplane 1	Cost of vehicle in transportation 3	Energy of vehicle in motion 1		Burn fossil fuel 3
Use		Some people will buy substitutes 2	Electricity resources are used 3		
Breakdown	Partial components 3	Maintenance cost 3		Scrap in maintenance 4	
Disposal				Emission of harmful gases during incineration 5	Electricity used in waste disposal 1
Secondary reuse		Cost of recycling 1			Energy is recycled -2

Through Matrix, we believe that the loss of raw materials and the waste generated such as toxic gases have the greatest impact on sustainability. Because most of the raw materials used in the manufacturing of bicycle saddles are non-renewable, they do not meet the requirements of sustainability. In addition, because the base plate of the bicycle saddle is mostly made of plastic, if we can reduce the price of plastic, the process of buying materials will be more convenient.

In addition, if we could recycle it, the cost of re-manufacturing would be much lower. Although there is a cost to recycle the used bike saddles, we can save even more money by reusing bike saddles components.

7.Design Opportunities

With the continuous development of bicycle saddles, the traditional hard saddles have been generally replaced by renewable or silicone saddles. After our analysis, the development of bicycle saddle has gradually changed to be more comfortable and sustainable. Nowadays, the new bicycle saddle takes environmental and social sustainability into consideration. I think the bike saddle of the future will be

environmentally friendly and socially acceptable. So I designed a new bicycle saddle, which is made of plastic bottles. **The plastic water bottle bicycle saddle which is designed by me has obtained the New Model Patent of our country.** The schematic diagram of the plastic bottle bicycle saddle is as follows:

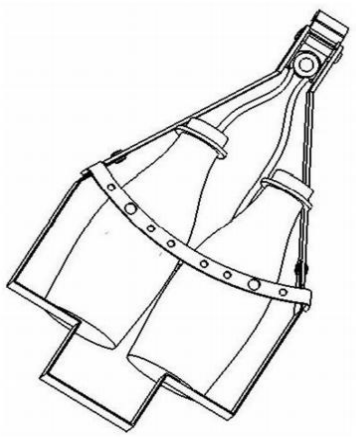

Figure 6：Plastic bottle bike saddle [5]

From the schematic, we can see that the bike saddle uses two plastic water bottles as the cushioning material. People can use gas in empty plastic bottles or liquid filled with water to dampen shock when riding. And if we use plastic bottles to be the saddle, we can use these wastes to achieve sustainable goals and generally protect the environment. In addition, the bicycle saddle is simple to manufacture, which means we do not need complex processing technology. [5] Therefore, due to these advantages, the market prospect is bright.

For **Sustainable Development**, this goal can be achieved with plastic water bottle saddles and other new materials. The plastic water bottle saddles are made from recycled or discarded plastic bottles. Therefore, the cost is very cheap and the bottles are easy to get and change. In the future, I believe there will be more sustainable products. The sustainable development of products has become very important and urgent for the world

8.References

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