# Product Analysis and its Improvement

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## 1 Product Analysis and evaluation

People design and manufacture new products continuously to improve the quality of life. A systematic analysis of existing or similar products should be made before designing and manufacturing new products. The results of the analysis will help us design a new product or improve an existing product. They can also lead to the development in scientific concepts and principles. Product analysis may help us learn and understand:

(a) How to use the products efficiently?

(b) How do the designers plan the functions of the products to satisfy specific needs of the consumers?

(c) How to use the products effectively to serve the purposes of their design?

(d) How to choose the materials for the products?

(e) What are the ways for manufacturing the products?

(f) What are the factors affecting the quality of the products?

(g) What are the implications of using the products for the economy, environment and human beings in the society?

Product analysis may also be used to analyse and compare the superiority and inferiority among some systems, such as transportation system, manufacturing system, quality control system, information system, etc. On the other hand, product analysis may help the consumers understand whether the design and quality satisfy their needs. This allows the consumers to make their choice wisely and reasonably before buying the new products.

| Scope of consideration | Questions |
|---|---|
| Reaction to the product | What are your preliminary reactions to such product? Are you willing to own it? Why? |
| | What do you think is its target? Why do you think likewise? |
| Demand for the product | Why is such product necessary? Why do you think you need it? |
| | Who will benefit from manufacturing it? How to make the product beneficial? |
| Design the product | Who makes the decision about its design? Are there other alternatives? |
| | How is the design of the product developed? |
| Manufacturing Process | What kinds of materials does it use? How to collect these materials? |
| | What kinds of resources can be used to manufacture such product? |
| | What are the influences to the environment and other people when using such materials and resources? |
| | How to eliminate the wastes produced in the manufacturing process? |
| | How about the working environment of the manufacturing plant? |
| Promotion of product | What is the brand name or image suitable for such a product? How to pack and promote it? |
| | Who are the target customers? What are the assumptions made concerning the target customers? |
| | What are the effects of the promotion? Will these effects harm or hinder anyone? Why? |
| Use of product | How does the use of the product affect the environment and other people? |
| Product disposal | Does the product include any reusable, renewable or recycled parts? |
| | How to dispose of its packing? How to eliminate the product or its relevant wastes? |

Table 1 Questions about the values of a product

Many people will think carefully whether a product is worth buying. But how should we evaluate a product? A product may have values in different aspects, such as technology, economy, environmental protection, society, atmosphere, ethics, etc. Products that are made from recycled paper have higher value in environmental protection. They are worth higher prices. Table 1 lists some questions about the values of products. The answers to those questions may help us evaluate a product.

Based on the answers to each question in Table 1, we can arrange the values of a product in the order of importance:

(a) Arrange the values in the order of their importance for the potential customers. How do the age, culture and habit of the customers affect the order?

(b) Arrange the values in the order of their importance for the manufacturers.

(c) Arrange the values in the order of their importance for the Green groups or pressure groups in the society.

# 2 Product Design

The results of product analysis and evaluation may be used to develop the design ideas and specifications. Product design can be divided into several stages as shown in Fig. 1. At the beginning, there are several reasons for the producers to develop new products, e.g. the unfulfilled marketing needs, a chance for new market, potential needs for consumers, values added by the application of re-design, the appearance of new technology, etc.

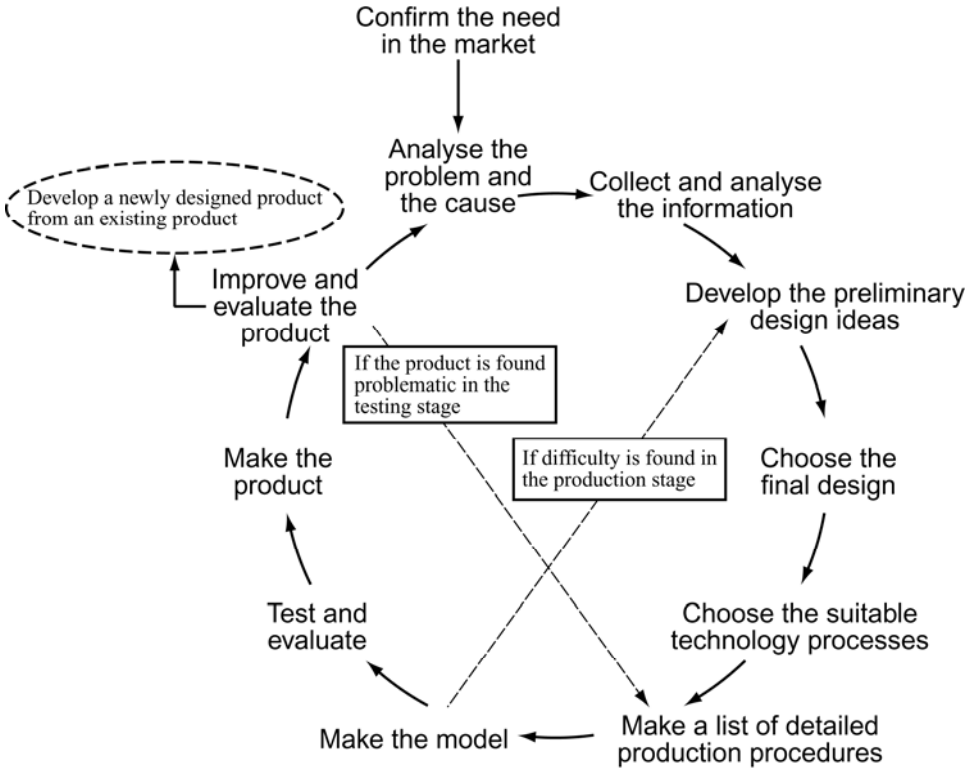



Fig.1 Different stages of Product Design

After the producer has decided on the ideas of a new product, a designer is entrusted with the development of the product. This is the second stage. In this stage, the designer will consider several factors which influence the product, such as functions, situations in which the product is used, costs, ergonomics, materials, safety, effects on environment, effects on users' health, use cycle, etc. The designer will then conduct a research, decide on the design specifications, draw the patterns of design, produce the models of design and design the process for mass production. Finally, the prototype of the design (also known as original model) is made and tested before it is put into formal production.

# 3 Functions and applications of products

The most important part of product analysis is to check whether the product achieves the aim of design, i.e. find out if the functions of such product fit in the consumers' needs. To review the functions of a product, considerations should be made on how comfortable and convenient the users can use the product. The following items may be considered before designing a product:

(a) Who will use such product?

(b) Why do they use such product?

(c) How do they use such product?

(d) Where do they use such product?

(e) When do they use such product?

The answers to these questions will form the primary conditions of the product. These conditions will then generate the features and functions of the product. This method can be used to find the features and functions of various products, such as an electric hair dryer.

Table 2 lists the primary conditions and features of an electric hair dryer for domestic use. We can then analyse and evaluate the functions of some existing electric hair dryers (Fig. 2).

| | **Primary conditions** | **Features** |
|---|---|---|
| (a) Who? | Persons with wet hair. One hand can be used only because the other hand has to hold a towel or a comb. | The users should reach their hands to the height of the hair comfortably. So the gross weight of the hair dryer should not be heavy.<br>The hair dryer should fit different sizes of the hand and prevent sliding.<br>It can be switched on and off by one hand. |
| (b) Why? | The hair can be dried in a short time. | A powerful electric fan should be used for blowing. |
| (c) How? | Air is blown through the heating element in the hair dryer and then the hair. Hot air makes the moisture evaporate quickly. | Heating element should reach about 70℃.<br>The element should be highly resistant to heat for a long time and will not melt.<br>The handle should not conduct heat. |
| (d) Where? | The hair dryer will be used in residential premises with power supply. | It should be operated with a power supply of 220V AC.<br>A safe and qualified three-pin plug should be used.<br>Persons holding the hair dryer should be protected from electric shock. |
| (e) When? | The hair dryer will be used after washing the hair or being wet by the rain. | The hair dryer should be handy for use.<br>The heating element should reach the specific temperature rapidly.<br>It should be durable. For example, it can be used for 10,000 times in average. |

Table 2 The primary conditions and features of a domestic electric hair dryer


(a) (b) (c)

Fig.2 Electric hair dryers in different styles

After listing the features, different kinds of products can be compared. The Consumer Council usually uses this method to analyse different products (Table 3). The table lists the main features of the products in the same category. Apart from features, information such as quality, price, etc. are also included. Numbers or symbols can be used to evaluate each product. Annotations may be added, if necessary, for describing specific features in detail. The general functions can then be compared.

| **Models** | **1** | **2** | **3** | **4** |
|---|---|---|---|---|
| In direct sunlight | ✓✓✓✓ | ✓✓✓✓ | ✓✓✓✓✓ | ✓✓✓✓ |
| Under illuminations | ✓✓✓✓ | ✓✓✓✓ | ✓✓✓✓✓ | ✓✓✓✓ |
| Manual adjustment | ✓✓✓✓ | ✓✓✓ | ✓✓✓✓ | ✓✓✓ |
| Still images | ✓✓✓✓✓ | ✓✓✓✓ | ✓✓✓✓✓ | ✓✓✓✓ |
| Select Scenes | ✓✓✓ | ✓✓✓✓ | ✓✓✓✓ | ✓✓✓ |

Table 3 Comparison of test results among the Digital Video cameras

We can use the above method to analyse and compare the functions of various products. They include household appliances, recreational amenities, office equipment and industrial equipment, such as vacuum cleaners, electric irons, gymnastic equipment, fax machines, etc. (Fig. 3).

(a) Vacuum cleaner

(b) Electric iron

(c) Gymnastic equipment


(d) Fax machine

Fig.3 Examples of products

# 4 Working principles of products

To fully understand whether a product functions effectively, we should conduct in-depth research and analysis. The following are some guiding questions:

(a) How to operate such product?

(b) What scientific principles are adopted in its operation?

(c) What kinds of raw materials or ingredients are used when it is in operation?

Many products are operated under the application of scientific principles, such as hair dryers, vacuum cleaners, electric irons, fax machines, gymnastic equipment, etc. The working principles of a hair dryer are shown in Fig. 4. Several scientific principles are applied. Similar methods may be used to analyse the scientific principles applied to other products.

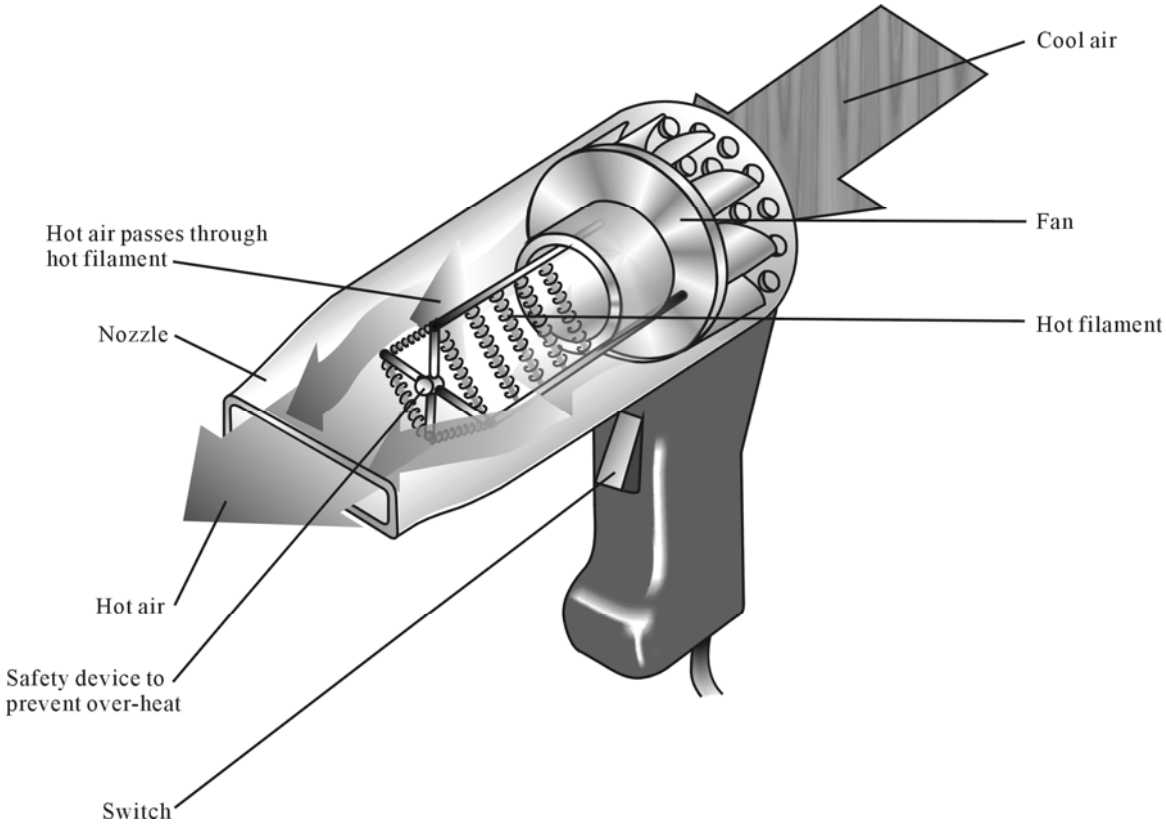



Fig.4 Working principles of a hair dryer

Table 4 lists some examples of the application of scientific principles. Electric motors are used in air dryer, vacuum cleaner and fax machine. The principles of electromagnetism are applied. Heating elements are used in hair dryer and electric iron. The principles of electricity are applied. In the working of fax machine, the principles of electronic circuit and telecommunication are applied. Gymnastic equipment is usually used to bear large effort and load. The principles of mechanics are applied. Following scientific development, several principles may be applied in one single product, e.g. electronic devices will be installed in new types of gymnastic equipment to record information during exercise.

| Products | Examples of the application of scientific principles |
|---|---|
| Hair dryer | Thermodynamics (Temperature sensor), Electricity (Heating element and switching circuit), Electromagnetism (Motor), Forces in fluids (Fan) |
| Vacuum cleaner | Electricity (Switching circuit), Electromagnetism (Motor), Forces in fluids (Exhaust fan) |
| Electric iron | Thermodynamics (Temperature sensor), Electricity (Heating element and switching circuit) |
| Fax machine | Electricity (Switching circuit), Electromagnetism (Motor), Electronics (Communications circuit) |
| Gymnastic equipment | Force (Mechanical parts), Ergonomics (Mechanical design) |

Table 4 Examples of the application of scientific principles

We can use tables to record the results when we study the scientific principles applied in products. Table 5 shows the example of an electric hair dryer.

| | |
|---|---|
| **Research target** | Electric hair dryer |
| **Products in the same category** | Heating machine, fan and other equipment with the use of motor and heating element. |
| **What is the function of the product?** | Air is blown through the heating element in the hair dryer and then to the hair. The hot air makes the moisture evaporate rapidly. |
| **How does the product operate?** | The electric current makes the motor and the fan rotate. It also flows through the heating wire and produces heat. Air is blown through the heating wire by the fan at the back and out in the front. |
| **Scientific principles** | The thermal power $P$ of the resistance wire is related to the resistance $R$ and the voltage $V$ by $P = \frac{V^2}{R}$.<br>The power of motor $P$ is affected by the resistance $R$, the voltage $V$ and the current $I$, $P = VI$.<br>The resistance wire, the motor and the switch form a complete circuit.<br>The principles of Forces in fluids may be considered to increase the speed for the air. |

Table 5 Scientific principles of an electric hair dryer

# 5 Materials and the manufacturing processes of products

The primary materials of products in early history of mankind were mainly natural, e.g. stones, leather, copper, iron, tin, timber, etc. With continuous development in science, new types of materials are available, such as steel, non-ferrous metals, plastics, glass, enamel, cloth, etc. For example, wood and metals were mainly used for manufacturing telephones in the old days. Modern telephones are made of plastics (Fig. 5).

In addition, new materials are produced by combining several materials under special processes. Plastic laminates, glass fibres, muscle wire, semiconductor are examples of new materials with new properties. Therefore, the process of choosing materials for products has become more complicated. Through the analysis of materials and manufacturing processes of different products, we can understand the merits and restrictions of different materials.

(a) Telephone in the old days

(b) Modern telephone

Fig.5 Different materials for telephones

We have to consider many factors when choosing the materials. These factors include costs, properties of materials, requirements of maintenance, product design, energy consumption, implications for the environment, market supply, safety, durability, etc. Costs and properties of materials are the most important factors in the choice of materials for the products. Table 6 lists some common properties of materials.

| **Common properties** | **Examples** |
|---|---|
| Physical properties | Density, melting point, boiling point, specific heat capacity, coefficient of linear expansion, thermal conductivity, electrical conductivity |
| Chemical properties | Oxidation reaction, acid resistance, alkaline resistance |
| Mechanical properties | Tensile strength, compressive strength, ductility, malleability, toughness, hardness, stiffness |
| Working properties | Moulding properties, forging properties, welding properties, cutting properties |

Table 6 Factors affecting the choice of materials

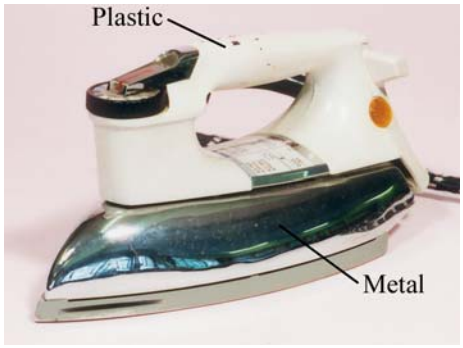
According to the functions and the features of products, we may choose the appropriate materials for different parts of the products. Hair dryer, electric iron, vacuum cleaner, etc. are operated by electricity. Insulated materials (e.g. plastics) with low electrical conductivity are chosen for the casing to prevent the users from electric shocks (Fig. 6). However, stronger metal casings protected by insulating materials may also be used for some large-scale vacuum cleaners.

(a) Fax machine

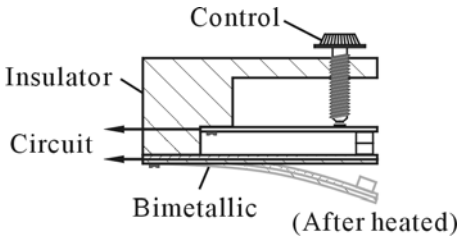
(b) Vacuum cleaner

Fig.6 Examples of plastic casings

The temperature of an electric iron is very high when it is in use. So, the materials used should be able to bear intensive heat. Materials with lower thermal and electrical conductivity (e.g. plastics) are usually used as its handle to prevent scalding. The base of the electric iron is responsible for conducting the heat produced by the heating element to the clothes. A metal plate with high thermal conductivity is used for rapid heat conduction (Fig. 7a). However, the surface of the metal plate should be treated in advance to make it smooth and not easy to oxidize. A metal with high resistance should be used in the heating element to provide enough power to heat up the plate. A double-layered metallic plate is usually used as a temperature sensitive switch in the electric iron to control the temperature (Fig. 7b).




(a) Electric iron




(b) Temperature sensitive switch

Fig.7 Electric iron

The material chosen for the product often influences its manufacturing process. For example, the choice of processes such as moulding, turning, milling, electric spark cutting, folding, stamping, polishing, electric-soldering, electroplating, etc. may be considered for metallic products. However, specific manufacturing processes have already been fixed for some products. For example, sawing processes are mostly adopted for products made in wood. The processing of products are mainly related to the chosen materials. Take an electric iron for instance, its plastic casing may be produced by injection moulding. The metallic base may be cast by metal and holes are drilled on it and processed.

We need to consider many factors when we choose the manufacturing process. They include the cost of the process, quantity produced, level of technology, resources, equipment, etc. Different manufacturing processes will affect the quality of product and the efficiency of production. For example, before the industrial revolution, craftsmen with individual skills produced all sorts of product. Therefore it was quite difficult to make sure each product has the standard quality. The quantity produced was also low. After the industrial revolution, as the technology improved and specialized, products were made in large quantities and the quality inspection was scientific. So the price was cheaper but the quality was more stable.

(Pictures source: Hong Kong Special Administrative Region)

Fig.8 (a) Traditional craftsman (b) Modern production in a pharmaceutical factory

The materials chosen for products are closely related to the manufacturing process. The interrelationship and relevant factors are shown in Fig. 9. Through the analysis of the manufacturing process for the products in the same category, we know the results achieved in various processes. These results help us choose the appropriate materials and processes in the new design.

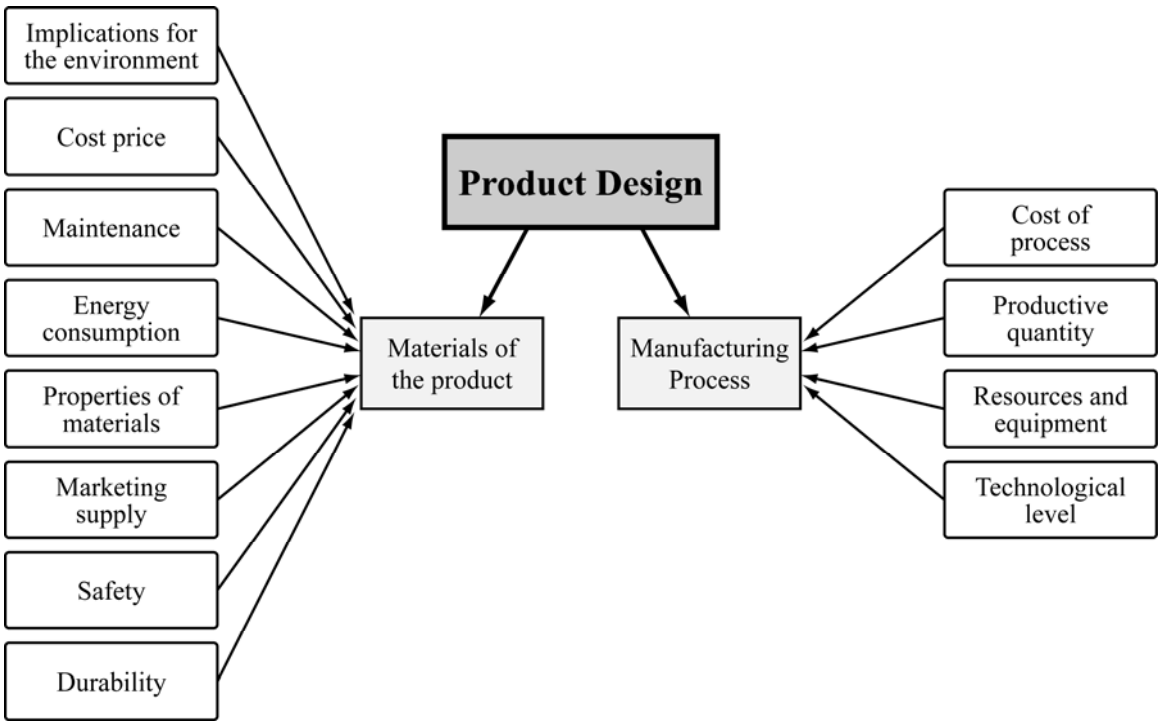



Fig.9 The relationship between materials and manufacturing processes

# 6 Quality of Product

The quality of a product will be influenced by several factors, including choice of resources, sense of beauty, ergonomics, process of combination, structure, control devices, suitability for the uses, safety, etc. Take an ordinary pen and pens of a famous brand for instance. Both of them can be used for writing. So they have the same function. However, a pen of a famous brand has a better quality (sense of beauty, ergonomics, structure, etc.). Its price may be hundred or even thousand times of that of the ordinary pen (Fig. 10). So we cannot analyse the value of the product only by judging its functions. Its quality should also be considered.

Fig.10 (a) An ordinary pen (b) Pens of a famous brand

## (a) Choice of resources

The resources chosen for the products include materials, manufacturing process, technology, etc. Take an ordinary porcelain teapot for instance. The raw material used is at very low price. Such teapots are produced by mass production with simple technology. In contrast, an exquisite teapot is produced using purple clay of the first-class quality and by an experienced craftsman (Fig. 11). Both products have similar functions of making tea but they are different in quality (include materials, sense of beauty, etc.).

Fig.11 (a) An ordinary porcelain teapot (b) Exquisite purple clay teapots

## (b) Sense of Beauty

Sense of beauty means the pleasant feelings produced by the product through all kinds of human senses including vision, touch, hearing, taste and smell. When we analyse the product, we should consider how it gives us pleasure. According to a scientific research, the human body receives about 80% of the messages in a day through vision. So the appearance of a product is very important. Several elements of vision are involved. They include colour, line, two dimensional shapes, proportion, visual combination, etc.

Colours may be an element of vision to impress people. Take the toys as an example. Bright colours are usually chosen to give relaxing or exciting feelings. In contrast, dark colours are usually chosen for equipment in an office to produce the feeling of stability and safety (Fig. 12).

Fig.12 (a) Toys in bright colours (b) Office stationery in dark colours

Lines may be divided into several types such as straight lines, curved lines, irregular lines, etc. They will give different feelings. Take the product with straight lines for instance. They give the feeling of speed, directness, frankness and terseness. In contrast, the product with curved lines give the feeling of softness, elegance and briskness (Fig. 13).

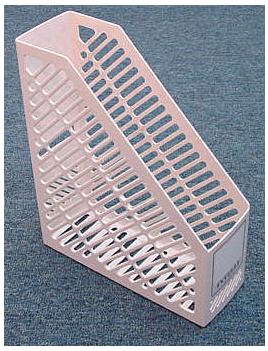


Fig.13 (a) Product with straight lines (b) Product with curved lines

Several kinds of two dimensional shapes may be produced in the form of geometry, unity, straight lines, irregularity, freehand, accident, etc. More regular shapes are usually used in textbook while irregular shapes are usually used in the comics (Fig. 14).

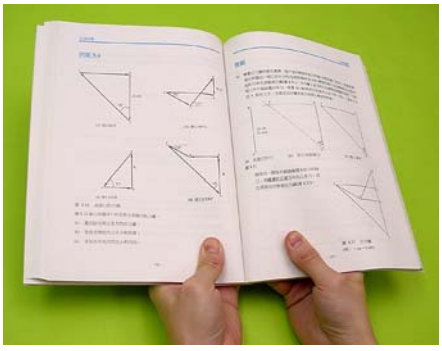


Fig.14 (a) Geometrical shapes printed in textbooks (b) Irregular shapes printed in the comics

The three-dimensional shape of a product means the volume of wrapping up its surfaces to build a three dimensional space. Three-dimensional shapes are very important for products such as motor design, casings of appliances, toys, etc. However, many designers think that three-dimensional shapes should cope with the functions of products. The appearances of cars are examples of different designs. Air resistance should be minimized for racing cars to move fast and for energy saving. In contrast, floats should emphasize the appearance and safety. As it usually moves slowly, fast speed is not required (Fig. 15).

Fig.15 (a) Streamlined vehicle

(b) A float in unique appearance

Proportion may provide some information. The two shadows in Fig. 16 may allow us to distinguish between a child and an adult.

Fig.16 Shadows of a child and an adult

Visual combination is another important element for the sense of beauty. Products usually include several elements of vision to create a unique style. The front view of a car has similar basic elements: headlights, rear-view mirror, air inlet, brand, etc. They like the organs on the face of human beings: eyes, ears, mouth, nose, etc. Different combinations of these elements project different images (Fig. 17).

Fig.17 (a) A family style vehicle

(b) An elegant style vehicle

Apart from the elements of vision, the qualities of products will also be increased by applying the feeling of touch, hearing, taste and smell. Touch allows us to sense the temperature, texture and shape. Warm and soft surface provides a comfortable and safe feeling. So it is commonly used for manufacturing the surfaces of seats and sofa (Fig. 18). Hearing can also give signals. The pleasant sounds emitted from many electronic devices when their keyboards are pressed let the users know the correct key is at work (Fig. 19).

Fig.18 Comfortable sofa

Fig.19 Electronic keyboard emitting sound signals

Taste is closely related to food (Fig. 20). However, people in different areas have different tastes. Take Sichuan people for instance. They like hot taste very much. On the other hand, aroma will also stimulate the appetite. A loaf of bread freshly prepared from the oven spreads a strong smell to attract customers. In addition, pinewood will emit a fragrant smell. Such a smell will also make pinewood products attractive. The factors above should be fully considered when we analyse the sense of beauty of a product.

Fig.20 Delicious food

# (c) Ergonomics

Ergonomics is a scientific research on the ways to co-ordinate human body with the environment so as to work or live efficiently. Consider the case of cashiers. Some of them need to sit on high chairs to work. Their legs will be away from the floor. Working for long hours will easily lead to muscles ache and decrease working efficiency (Fig. 21a). If a footrest is put to support the legs, the chance of getting muscles ache can then be minimized and the working efficiency will be increased.

Fig.21 (a) Sitting on high chair lifts the legs up from the floor (b) Using a footrest to support the legs

Ergonomic research makes use of data and information of the human body to improve the product design. The clothing manufacturers, for instance, can set different standards for sizes (XS, S, M, L, XL, etc.) by using data of male and female adults, and children to make the clothes. Many types of equipment are also designed using ergonomic findings. The latest model of a mouse can support the hand comfortably (Fig. 22a).

Fig.22 (a) A mouse (b) A height-adjustable chair

In addition, flexibility will also be added to the design of many products. For example, a height-adjustable chair can serve people with different heights. When we analyse the quality of products, we should do a research to see whether ergonomics is applied to increase the working efficiency of the users and their degree of comfort.

# (d) Process of Combination

Different parts are combined to make a product. The process of combination will affect the quality of the product. Fig. 23a shows the components that are combined to form an electric hair dryer. If there is something wrong in the process of combination, a hair dryer cannot be made operative. Today, some furniture need to be assembled by the customers themselves. These products should have very good design (Fig. 23b). Otherwise, customers are unable to assemble the products properly.

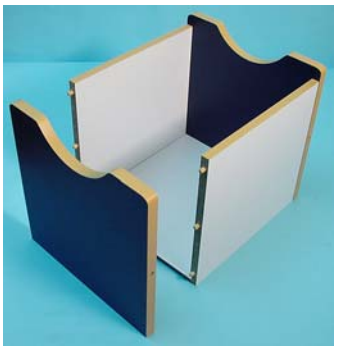
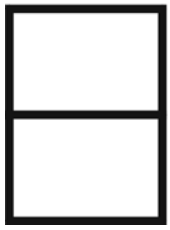
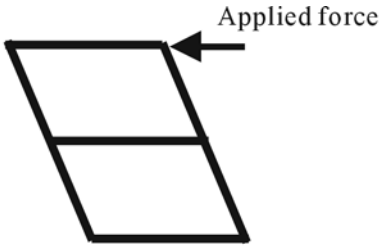


Fig.23 (a) The components of an electric hair dryer (b) Self-assembled furniture

## (e) Structure

The stability of a product depends on its structure. A cabinet made from pieces of wood may appear to be very stable (Fig. 24a). Yet it will deform easily if a lateral force is exerted on it (Fig. 24b). The stability of a cabinet will increase if two pieces of veneer are added (Fig. 24c). To analyse the quality of products, their structure should be considered.





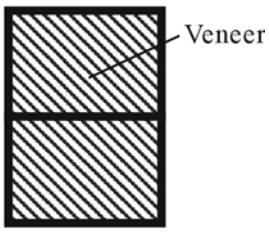




Fig.24 (a) A simple cabinet (b) It deforms when a force is applied to it. (c) A cabinet not easily deformed (Rear View)

Products usually last a long time. Very often, they may be acted upon by external forces. So they should have a strong structure. Electric hair dryer and electric iron are products with strong structures. Slight collisions may not cause any damage.

## (f) Control devices

Many products will use control devices to regulate their functions. Consider the air-conditioning system in motor vehicles. It usually has temperature switches. Simple knobs are used to control the temperature. But they are not very accurate (Fig. 25a). Thermostatic control devices are often used to keep the temperature at specific levels (Fig. 25b).

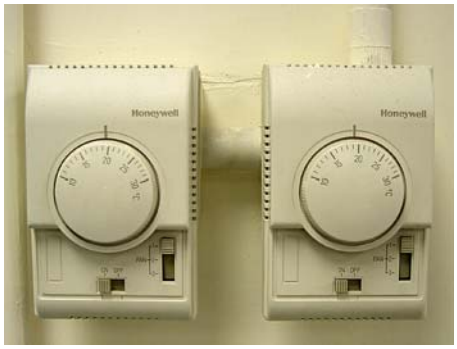




Fig.25 (a) Simple temperature switches (b) Thermostatic control devices

# (g) Suitability for use

Apart from the main functions, a product usually has some supplementary functions. The main function of a watch, for example, is to keep time. But watches of different styles have different supplementary functions. A sports watch usually has a function of measuring the time for running or exercise. A 'Submariner' watch will have a high water resistant function for it to work properly in deep water. Luxurious design and appearance will be emphasized for cosmetic watches that are meant for the special image of the users (Fig. 26).

Fig.26 (a) Sports watch (b) Submariner watch (c) Cosmetic watch

Products should be used in a suitable way for maximum benefits of their functions. If you wear a cosmetic watch to go swimming or diving, the consequences may be disastrous. So the suitability for the use should be considered when analysing the quality of products.

# (h) Safety

If a product is hazardous to the users' health or leads to accidents, then it is a dangerous product. Many countries have set up standards of product safety and testing methods. They also impose heavy penalty on the merchants who manufacture and sell dangerous products. Safety precautions should be taken in the processes of manufacturing, using, storing, transporting and disposing of products. When we analyse the safety of products, the potential hazards in all processes should be located.

Comparison among the safety designs of gas cookers is a good example. Coal gas is used for cooking in many families. As the gas is toxic and inflammable, leakage will be dangerous and fatal. Some gas cookers will have additional safety devices, such as a switch that stays at a location of 'fully off' or 'in use', to avoid the leakage of gas from switching off incompletely (Fig. 27a). If a safe valve is added into the gas ring, the air outlet will be closed automatically when the gas stops burning. This prevents the leakage of gas if the fire has gone out (Fig. 27b). Obviously, gas cookers with anti-leakage devices are safer.


Fig.27 (a) A switch of gas cooker (b) Gas ring in a gas cooker

# 7 Implications of products

## (a) Social

Social implications should be considered when a product is analysed. Take a lift for instance. Its implication for the society is great. Before the invention of the lift, few people like to live in upper floors, as they have to climb many flights of stairs. After the invention of the lift, people living on high storeys can go home conveniently. So more and more high-rise buildings are erected (Fig. 28).

Fig.28 High-rise buildings in Hong Kong

The dramatic development of electronic products also brings great changes in the society in the past decades. Radios and televisions spread messages throughout the World in a short period of time. Fax machines, mobile telephones and the internet also facilitate world-wide communication. Electronic calculators, computers, digital diary have greatly increased working efficiency. So the production of a new product may have great and far-reaching effects on the society.

# (b) Environmental

There is a very intimate relationship between human beings and environment. Scientific and societal developments, however, change such relationship. The construction of roads and bridges, development of shopping arcades, building of new transportation facilities and public utilities, etc. may improve the environment and make it more suitable for living. But they may also provoke conflicts. When the transportation system extends to outlying areas, it also brings destruction to the natural environment and pollution (Fig. 29).

Fig.29 Extension of transportation system to outlying areas destroys wildlife

The following questions may be considered when we analyse the environmental implications of products or systems:

1. What are the environmental implications of using such products?
2. Are there any reusable and replaceable resources in such products?
3. How many non-recycled resources do such products use?
4. How much wastes do such products produce? Can this kind of waste be recycled?
5. Do such products use biodegradable materials?
6. How much energy is used for making such products? What kinds of energy resources are used?
7. Will the wastes of such products produce toxic gases or harmful substances?
8. Do such products contain any dangerous substances such as radioactive substances or heavy metals?

# (c) Human

Many new products not only increase the users' quality of living, but also change their habits of living and health. For example, although motor vehicle can increase the movable area of human beings, it brings serious air pollution to them and harms their respiratory systems. Similarly, televisions can bring information and entertainment to many families, the family members may have less intercommunication, change the reading habits, affect the eyesight of the children, etc. So the far-reaching effects on the human beings should be observed when we analyse a product.


Fig.30 (a) Vehicle exhaust is hazardous to health (b) Television affects the visual development

# 8 Product Improvement

We may refer to the methods of product analysis above to help us improve the existing products. In fact, many new designs are developed from the existing products. Take the car manufacturers for instance. Their products should often be updated to combat the competitors. So car manufacturers will always improve their existing products and develop new designs by applying the latest technology (Fig. 31).

Fig.31 (a) Motor vehicle in the 70's (b) Motor vehicle in the 21st century

Product improvements may cover areas such as designs, functions, working principles, materials, manufacturing processes, quality, social, environmental and human implications.

## (a) Improvement in design

After analysing the designs of similar products, the designers can design the new ideas to meet the functional requirements for the development of new products. Fig. 32a shows a clipboard hanging the document beside the computer, which facilitates the computer users to read the document and input the text simultaneously. However, this type of clipboard has many shortcomings. Its size is big. It falls easily and the papers will always swing from side to side. So products in better designs are desirable.

Therefore, a new design as shown in Fig. 32b was introduced. It overcomes the shortcomings of the original design and makes the users more comfortable when using this product.



Fig.32 (a) Hanging clipboard (b) Clip stand

# (b) Improvement in functions

The functions of a product always need to be improved with technological and societal developments. The main conditions of use and applications of the product should be listed when we analyse the design of the product. Then improvements can be made. Take the telephone for instance. Its main function is to allow the users to communicate. However, old-fashioned telephone only has the function of transmitting the message through sounds (Fig. 33a). Today, videophone can improve that function. It can transmit the messages by vision and sounds (Fig. 33b).

Fig.33 (a) Old-fashioned telephone (b) Videophone

# (c) Improvement in working principles

When new technology is invented and used, the working principles of some products can also be improved. Take cooking for instance. Fuel or electricity is usually required to produce heat for the cooking ranges, transmitting the heat to the food from outside (Fig. 34a). However, when microwave was found to make the water molecules in food vigorously vibrate to produce heat, engineers designed and built the microwave ovens for cooking (Fig. 34b). New working principles are adopted in this type of new product. Microwave oven has many advantages. It can cook food without the emission of large amount of heat and greasy fumes. It keeps the environment clean, so it can be put in many places such as office, living room, convenience store, supermarket, etc. It also changes the cooking habits of many people.

Fig.34 (a) Old-fashioned cooking ranges (b) Microwave oven

# (d) Improvement in materials and manufacturing process

There are many advantages in using different materials to manufacture products. Take the soft-drink bottles for instance. The old-fashioned bottles were made of glass. Hence, they were expensive. The systems of cleaning and recycling glass bottles for further use had to be set up (Fig. 35a). When plastics were introduced to the manufacturing of soft-drink bottles, the prices of bottles were reduced. Cleaning and recycling bottles for further use were not required. This makes the production cost lower (Fig. 35b). Furthermore, plastic soft-drink bottles are light and not easy to break. So soft-drink bottles of larger capacities can be produced.


Fig.35 (a) Glass bottle (b) Plastic soft-drink bottles

The manufacturing processes will also be changed following the changes in the materials of products. Glass bottles are produced by blowing molten glass. The production time is long and the process is difficult to be automated. So productivity is usually low. In contrast, the plastic soft-drink bottles can be produced in large quantities by the automatic blow-moulding machine. So productivity is higher.

# (e) Improvement in quality

When a product with new functions has just been invented, users would pay great attention to its functions and they can tolerate its worse quality of the design such as sense of beauty, ergonomics, control devices, etc. But when such product is commonly used, the users will pay attention to its other features. Take the mobile phone for instance. The mobile phone in early period was not only bulky but also very heavy. Because of its outstanding convenience, this kind of product was welcomed by the users (Fig. 36a). However, when mobile phones are commonly used, their sizes become smaller and weights lighter. The users pay more attention to its quality. For example, the cases in exquisite designs and more accessories can increase the sense of beauty, the application of ergonomics for the design of appearances, the addition of voice-activated function as control devices, etc. (Fig. 36b).


Fig.36 (a) Mobile phone in early period (b) Exquisite mobile phone

## (f) Improvement in social, environmental and human implications

The appearance of new products and materials often has social, environmental and human implications. For example, a large quantity of polyfoam containers are disposed after use. They cannot be decomposed easily. So they are harmful to the environment (Fig. 37a). To improve the implications of product for the environment, containers made in recycled paper may be considered to replace polyfoam (Fig. 37b).

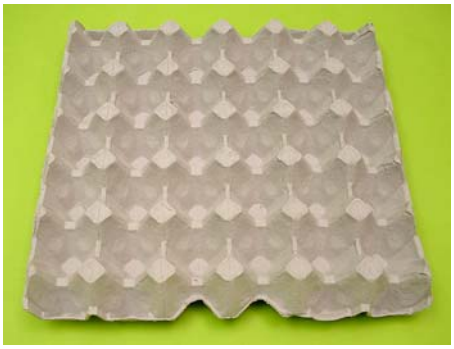


Fig.37 (a) Polyfoam container (b) Container made in recycled paper

# 9 Practical example for designing and improving the product

A group of students have conducted a research on domestic luminous lamp for drafting a design project. An example of the domestic luminous lamps is shown in Fig. 38. The analysis of their scientific principles can help design the new products. Table 7 lists the scientific principles of domestic luminous lamp.

Fig.38 Domestic luminous lamp

| | |
|---|---|
| **Project title** | Design and make a domestic luminous lamp. Light can be emitted automatically in the dark. The safety light should also have a switch for the users to turn it off. The system should be safe and easy to operate. |
| **Products in the same category** | Infrared body temperature sensors, street lamps, other equipment with a light sensor. |
| **How to use the product?** | The master of the household switches on the domestic luminous lamp before going to bed. When the indoor brightness reduces to a specified level, the luminous lamp will emit a faint light automatically. When all major lights are switched off, the master of the household will not bump into objects in the dark. Children will also have a sense of security when they sleep. |
| **How does the product operate?** | A light sensor is used to monitor the indoor brightness. The on and off switch of the bulb can be controlled by the signals emitted by the electronic circuit. |
| **Scientific principles** | The resistance of the Light Dependent Resistor (LDR) changes according to the brightness. Potential divider is used to send the signals of voltage. A transistor is used for signal processing and relay control. The relay is then used to turn on or off the bulb. |

Table 7 An example of using scientific principles

If we have to improve the domestic luminous lamp above, we may consider its design, functions, working principles, materials, manufacturing process, quality and the social implication, etc. For example, an infra-red sensor may be added to make the luminous lamp light up only in the dark and when somebody is moving. The improvement of this kind of design may minimize the effects of the light. A luminous lamp in the same design is shown in Fig. 39. In addition, the appearance of luminous lamp can also be improved to increase its sense of beauty, e.g. its shape and colour may be changed in the form of star and moon.

Fig. 39 Luminous lamp with a sensor

# Exercise

1. Draw a diagram to illustrate the different stages of product design.
2. Which of the five factors has to be considered before finding the functions of a product?
3. State the factors in choosing the materials for making a product.
4. Draw a diagram to illustrate the relationship between the materials and the manufacturing processes.
5. State the factors influencing the quality of a product and elaborate with an example.
6. In analyzing the influence of a product or a system on the environment, what aspects should be considered?
7. From what ways can we improve a product?
8. Below are three examples of the improved products: Fig. 40a shows a LCD (Liquid Crystal Display) television whose size is lighter and smaller than the traditional one. While the radiation emitted from the LCD television is much diminished, but its resolution is very high. A newly designed bus stop shown in Fig. 40b provides the information of the bus routes and other information for the passengers to search the desired routes. Fig. 40c shows a refrigerator which can check the amount of food inside. The refrigerator can automatically order those foods consumed through the internet according to the prepared purchase information.

   The mentioned products are newly designed, and their functions are better than those before. Choose one of these products and design a new outlook for it, adding sophisticated functions with the elements of information technology, and make it user friendly.

   Project requirements:

   (a) Elaborate the design ideas in 200 words;

   (b) Use graphics to show the outlook of the design of the product;

   (c) Design an A4 sized leaflet to introduce the functions and the user guides of the product.

(a) A LCD television


(b) A newly designed bus stop that can provide various information and bus routes for passengers

Fig. 40 (c) Food ordering can be done by the internet connected refrigerator