

# Design and Applied Technology

( Secondary 4 - 6 )

## Learning Resource Materials

### Value and Impact

Strand

III

Values in **Technology** and Design

Historical and **Culture** Influences

**Entrepreneurship** and Enterprise

# **Design and Applied Technology**

## **(Secondary 4 – 6)**

### **Compulsory Strand 3**

#### **Value and Impact**

**[Learning Resource Materials]**

**Resource Materials Series**  
**In Support of the Design and Applied Technology Curriculum**  
**(S4 – 6)**

**Technology Education Section**  
**Curriculum Development Institute**  
**Education Bureau**  
**The Government of the HKSAR**

**Developed by**  
**Institute of Professional Education**  
**And Knowledge (PEAK)**  
**Vocational Training Council**

**Technology Education Section**  
**Curriculum Development Institute**  
**Education Bureau**  
**The Government of the Hong Kong Special Administrative Region**  
Room W101, 1/F, West Block, Kowloon Tong Education Service Centre,  
19 Suffolk Road, Kowloon Tong, Hong Kong

Reprinted with minor amendments 2010

**Project Advisor:**

Mr. O Hin Ming, Brian (Head, Department of Engineering, IVE/ Tsing Yi, VTC)

**Authors**

Miss Chan Yat Ning, Vicky	(Teaching Associate, Department of Engineering, IVE/ Tsing Yi, VTC)
Mr. Cheng Che Yung, Andrew	(Lecturer, Department of Engineering, IVE/ Tsing Yi, VTC)
Mr. Chu Kin Cheong	(Lecturer, Department of Engineering, IVE/ Tsing Yi, VTC)
Mr. Fung Ka Shuen	(Lecturer, Department of Engineering, IVE/ Tsing Yi, VTC)
Mr. Fung Siu Kei, Ringo	(Lecturer, Department of Engineering, IVE/ Tsing Yi, VTC)
Mr. Lau Hok Keung	(Lecturer, Department of Engineering, IVE/ Tsing Yi, VTC)
Dr. Lo Ka Wah, Joe	(Lecturer, Department of Engineering, IVE/ Tsing Yi, VTC)
Mr. Lee Tak Wai, Geddy	(Lecturer, Department of Engineering, IVE/ Tsing Yi, VTC)
Dr. Shiu Yiu Cheung, Greg	(Senior Lecturer, Department of Engineering, IVE/ Tsing Yi, VTC)
Mr. Wu Yat, Kevin	(Lecturer, Department of Engineering, IVE/ Tsing Yi, VTC)

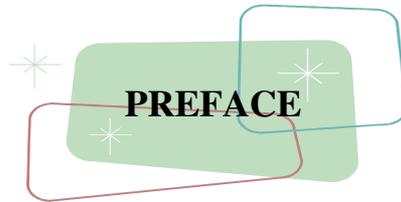
**Project Coordinators:**

Mr. Li Yat Chuen	(Senior Training Consultant, PEAK/VTC)
Mr. Tsang Siu Wah	(Training Consultant, PEAK/VTC)

The copyright of the materials in this package, other than those listed in the Acknowledgments section and the photographs mentioned there, belongs to the Education Bureau of the Government of the Hong Kong Special Administrative Region.

© Copyright 2009

Duplication of materials in this package other than those listed in the Acknowledgements section may be used freely for non-profit making educational purposes only. In all cases, proper acknowledgements should be made. Otherwise, all rights are reserved, and no part of these materials may be reproduced, stored in a retrieval system or transmitted in any form or by any means without the prior permission of the Education Bureau of the Government of the Hong Kong Special Administrative Region.

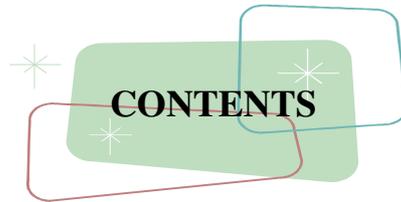


A set of curriculum resource materials is developed by the Technology Education Section of Curriculum Development Institute, Education Bureau for the implementation of the Design and Applied Technology (Secondary 4-6) curriculum in schools.

The aim of the resource materials is to provide information on the Compulsory and Elective Part of the DAT (Secondary 4-6) to support the implementation of the curriculum. The resource materials consist of teacher's guides and student's learning resource materials of each Strand and Module of the DAT (Secondary 4-6) arranged in eight folders.

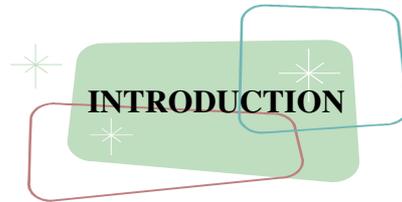
All comments and suggestions related to the resource materials may be sent to:

Chief Curriculum Development Officer (Technology Education)  
Technology Education Section  
Curriculum Development Institute  
Education Bureau  
Room W101, West Block, 19 Suffolk Road  
Kowloon Tong  
Hong Kong



## **Introduction**

<b>Chapter 1 – Values in technology and design</b>	1
1.1 The changing roles of the designers and engineers in society	2
1.2 Intellectual property	8
1.3 Product evaluation	13
1.4 Environmental responsibility	21
1.5 Appropriate technology	29
<b>Chapter 2 – Historical and cultural influences</b>	35
2.1 Evolution of craft and design	36
2.2 Design and culture	44
2.3 New technology	49
<b>Chapter 3 – Entrepreneurship and enterprise</b>	54
3.1 Competitive edge of Hong Kong	55
3.2 Design to meet market aspirations	60
3.3 Design strategies	68
<b>Theme-based Learning</b>	72
• Case Study of the motion-powered light torch	72
• Case Study of the evolution of wire rotary dial telephone to wireless mobile phone	74
• Case Study of the design of an interactive game for a theme park in Hong Kong.	76
<b>Assessment Tasks</b>	78
• Case Studies	78
• Practical Task	80
• Quizzes	81
<b>Useful Websites</b>	110
<b>Glossary of Terms</b>	111
<b>References</b>	116
<b>Acknowledgements</b>	117



## INTRODUCTION

The roles of designers and engineers in product design and to the society as a whole are very important because they are responsible for the making of products which are contributing to the wealth of the society, the growth of economy and preserving the environment. Therefore they are expected to observe the right of intellectual property, able to evaluate products, be environmental conscious, and be aware of using appropriate technology for the manufactured products.

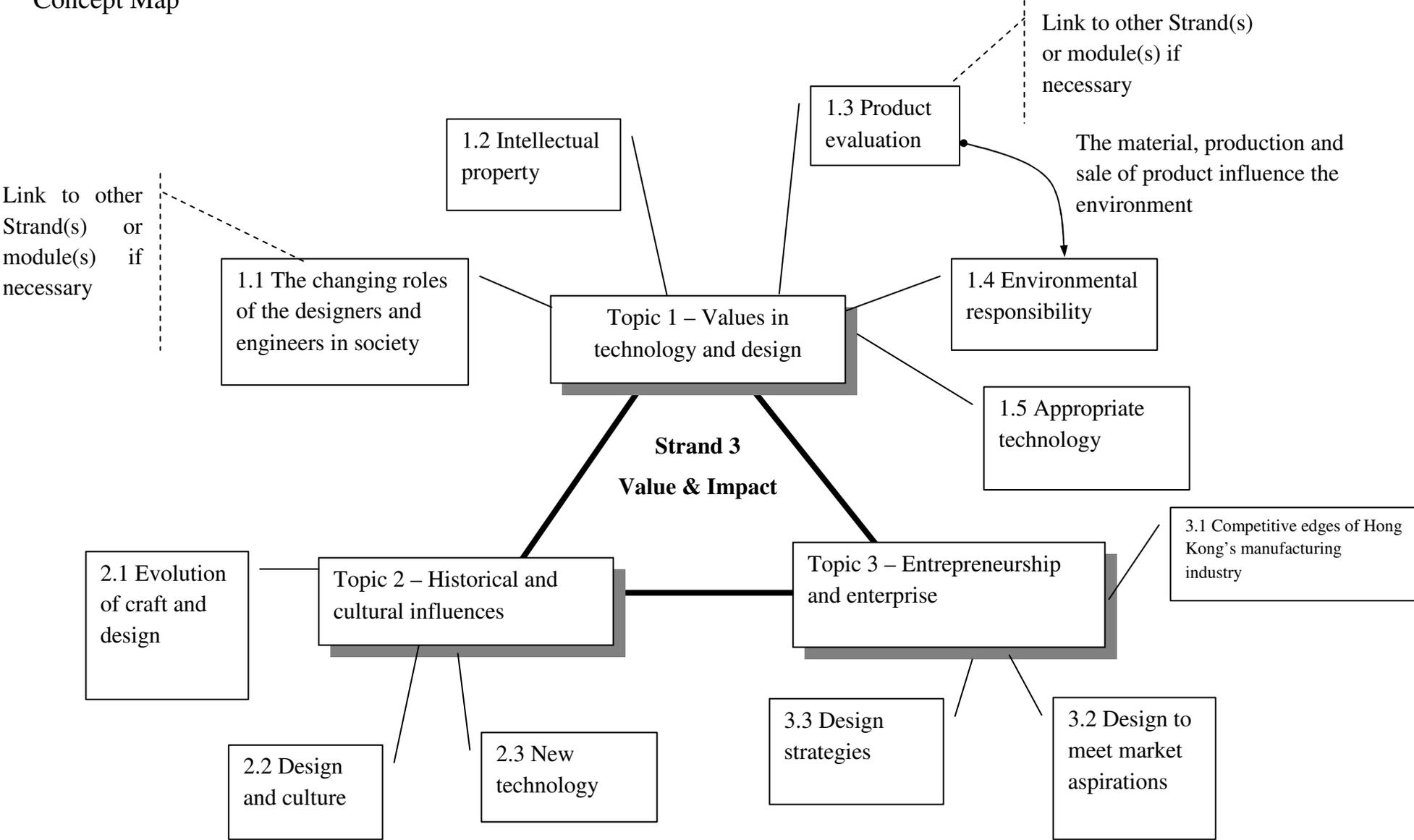
In order to being able to design quality, attractive and popular products, designers should be aware of the evolution of craft and design, the different cultures and effects on the designs, and the new technology in the market.

Hong Kong is a prosperous and successful international city; what are the competitive edges that allow Hong Kong in a driving seat when competing with other nations? The prevailing design strategies adopted by the Hong Kong manufacturers are discussed in Chapter one. The Chapter also highlights the important roles played by the designers and engineers and what professional ethics they should have in order to be a good designers or engineers.

Chapter two discusses that designers and engineers should acquire the knowledge of evolution of craft and design, the impact of design culture and new technology because they help designers and engineers to develop quality and marketable products.

You will learn in Chapter three the competitive edges for the industry in Hong Kong and the different stages in making a product which meets the market aspirations. You will also understand different design strategies: Original Equipment Manufacturing (OEM), Original Design Manufacturing (ODM) and Original Brand Manufacturing (OBM).

# Concept Map



## CHAPTER 1 VALUES IN TECHNOLOGY AND DESIGN

This chapter covers topics on:

- (a) The Changing Roles of the Designers and Engineers in Society
- (b) Intellectual Property
- (c) Product Evaluation
- (d) Environmental Responsibility
- (e) Appropriate Technology

These topics include learning materials and activities that facilitate the students to

- (i) Identify the impact and value of design;
- (ii) Understand the value of intellectual property;
- (iii) Analyse and evaluate manufactured products;
- (iv) Be aware of the environmental issues related to design, production and the sale of products; and
- (v) Understand the needs of resource conservation.

## 1.1 THE CHANGING ROLES OF THE DESIGNERS AND ENGINEERS IN SOCIETY

Designers and engineers are important to society in the sense that they help

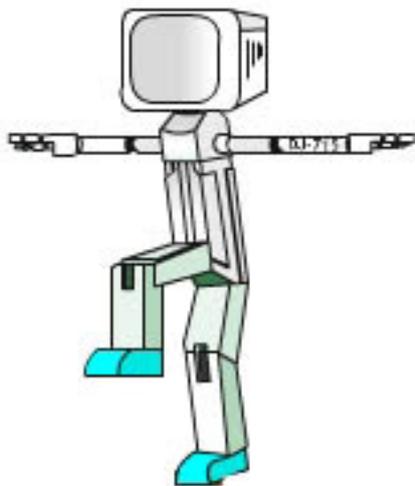
- (a) Build society;
- (b) Shape culture;
- (c) Enrich people's quality of life; and
- (d) Contribute to the economy's growth.

Designers and engineers should not only design and fabricate products that meet user's needs, but also observe their roles on social responsibilities.

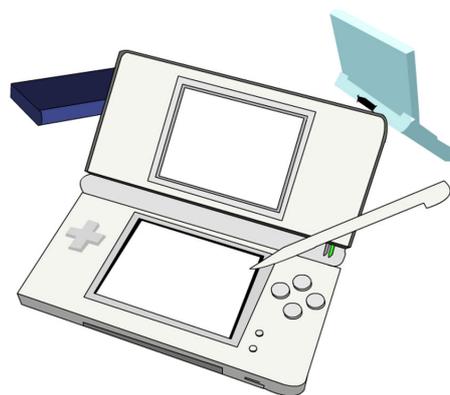
### 1.1.1 Impact and Value of Design

An improperly designed or planned product might lead to call back and in extreme case might cost someone's life. The possible consequences explain the utmost importance of proper design of a product. Therefore, designers and engineers have to ensure that every single part or stage of a product in its manufacture process is in order. In short, a designer or an engineer should observe the following in design and production:

- (a) Be user-oriented;
- (b) Focus on health and safety;
- (c) Observe professional ethics; and
- (d) Concern on the disposal of products.



Robot



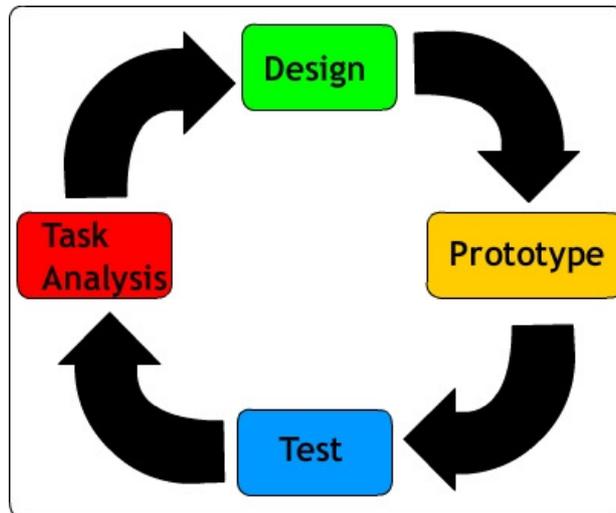
Nintendo DS (NDS)

Robot toys and Nintendo DS (NDS) are very popular in the toy market. They have been designed to be attractive, easy to use, interactive, challenging and enjoyable to customers of all ages.

Being an international organisation specializing in toy design, Hasbro has its own research and development team. The team is responsible for studying, designing and building toys, such as Transformers. The attractiveness of their products partly comes from the need for players to exercise imaginations and skills while playing. The toys challenge the players with complicated engineering structures and countless assembly combinations.

### 1.1.2 User-centred Design

During product creation, the first thing designers and engineers have to consider is ‘user-centred design’, or UCD. UCD is a design philosophy or approach. A UCD process takes end users’ needs, wants and limitations into consideration at each design stage. UCD can be considered as a set of multi-stage problem solving skills: Designers have to analyse and anticipate how users will use an interface, and to verify the validity of assumptions made on user behaviours against reality. Such verification is important because what a first-time user experiences and how each user’s learning curve looks like are often, if not always, unpredictable.



Product Design/Development Cycle Relationship

Designers are expected to be able to meet the goal of a product made for their users by going through UCD:

- (a) All necessary user requirements can be considered properly along the product development cycle;
- (b) Real users can participate in the product development cycle;
- (c) The product is designed through iteration.

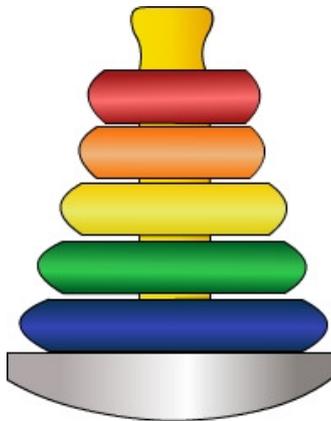
In short, it is a user-centred design process. Instead of forcing users to adapt a system or function, such a design process takes care of how users can, want to, or need to work.

Another aspect designers and engineers have to consider during product design is the health and safety as well as effects to their users. The health and safety assessment is the careful

examination of what can cause harm to people and how the product is built in accordance to the health and safety regulations. Unsafe products can be subject to recall which ends up the loss of everything.

Other concerns include, but are not limited to:

- (a) As an integrated approach, how a product is manufactured, stored, carried, used, disposed and recycled;
- (b) The possibility and impact of hazards when a product is used. For example, loose and small parts of a toy could be swallowed by children, while sharp edges could cause body injury;



Hazard due to lead poisoning in products

- (c) Lead poisoning hazard from a product's coat paint;
- (d) Whether or not risks have been managed properly; and
- (e) How a product is operated safely, without causing adverse impact on people.

## H I G H L I G H T

### Successful products

Explain, from the following perspectives, why iPod is attractive and popular among young people:

- (a) User centred;
- (b) Observant of health and safety regulations;
- (c) Professional ethics; and
- (d) Environmental issues.

### 1.1.3 Social Responsibilities: Professional Ethic and Disposal of Products

The topic of social (corporate) responsibilities is hot in society; designers and organisations have to observe without exception. It is important that designers be aware of the consequences that their designs may lead to the product users and society as a whole. The social responsibilities include, but are not limited to:

- (a) Safety of the products,
- (b) Compliance with recognized professional ethics, and
- (c) Environmental friendliness of the products themselves and the materials used.



Many people dispose products simply because they no longer like or use the products. Such disposal behaviour however results in environmental problems and conservation of resources.

In Hong Kong, unwanted matters are collected from households and disposed currently to the three major landfill sites. Unfortunately, due to the continuous growth in wastes, Hong Kong is running out of landfill space in an unexpectedly high rate. In order to address the issue, one of the possible ways is recycling, i.e. tackling the problem at its source.



## H I G H L I G H T

### Social responsibilities

Social responsibility refers to the quality associated with good and high-quality designers and engineers. Explain the consequences of waste disposal if social responsibilities have not been taken up properly.

#### 1.1.4 Make informed decisions on purchasing manufactured products

A product causing the least problems and welcomed by users can be considered as quality design and engineering work. The following points can help consumers make informed purchasing decisions:

- (a) Quality products heavily rely on workmanship and materials;
- (b) Products should be designed and built by right people with the right facilities;
- (c) Products should at least fit their original purposes, be user-friendly, be robust, be recyclable, and be environmental friendly;
- (d) Products' safety and compliance with specifications and standards provide customers, especially children, with fundamental protection;
- (e) Guaranteed repair and maintenance as well as after sales services provide customers with further protection; and
- (f) There should be refund, recall or redemption arrangement for defective products.



Recyclable Products



Product requires guaranteed repair and maintenance.

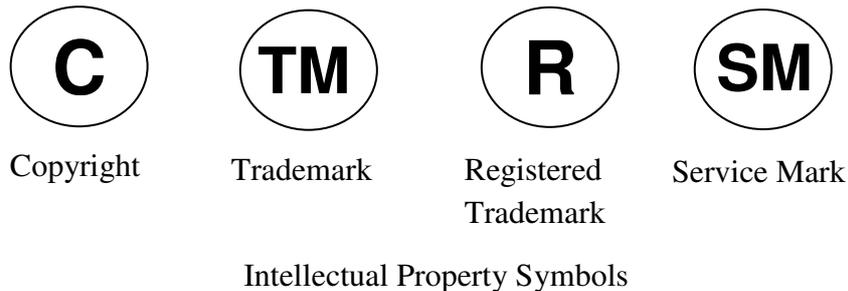
**S T O P   A N D   T H I N K**

**Case Study**

If you, a designer, have to design a toy to be launched this Christmas, what will you do to make the toy popular and environmentally friendly?

## 1.2 INTELLECTUAL PROPERTY

‘Intellectual property’ refers to intangible property rights. It is different from physical property rights of tangible objects. The family of intellectual properties have members of trademarks, patents, copyright, registered designs, etc. They are living around us, such as brand names, logos on clothes, articles in newspaper, TV programmes, pop songs, films, computer games, and fashion designs.



Protecting intellectual properties can be understood as protecting creativity. However, some ideas may not be protected. For example, in order to balance the interests of different sectors in society, a pharmaceutical invention may be protected by patent registration, but a special medical treatment not.

### 1.2.1 The value of intellectual property and the principles of legal protection of design

To have an environment that creativity and hard work are encouraged and rewarded, the efforts of artists, designers, writers, inventors, programmers and other talents have to be protected. Unlawful duplications discourage creators’ creativity and hard work.

In Hong Kong, the party responsible for formulating policies and legislation on intellectual property as well as implementing public education programmes is Intellectual Property Department. At the same time, the Customs and Excise Department is responsible for fighting against infringement of intellectual property rights.

### 1.2.2 Copyright

Copyright does not suppress an idea, but protects the expression of the idea, i.e. how the idea is expressed or presented. Expressions recorded in tangible items (or works) are protected by copyright. For example, written records, sound recording, pictures and photographs, original literary works, script, lyric, drama, music, technical drawings, sculptures, software, films, broadcasts, cable programmes and layouts of published works. Normally, the creator of an item is the first copyright owner.

Copyright arises automatically when an item is created, requiring no registration. In Hong Kong, the symbol of “©” is commonly used to remind people of respecting copyright. The

symbol itself does not mean the item has been registered.

The valid period of copyright protection is 15 years or more in general. A full period for an artistic work covers the life of the author plus 50 years after the author's departure.

### **1.2.3 Patent**

Inventions are protected by patent registration which gives exclusive rights to the inventors or patent owners. A patent holder can manufacture, use and sell products on the patented invention. The holder's investment is protected against unauthorized manufacturing, use, sale or import of products on the patented invention. Patents are granted for new, inventive and industrially applicable inventions only.

In most countries, patent protection lasts for up to 20 years. The protection is valid as long as renewal fee, often in an annual basis, is paid.

### **1.2.4 Trademark**

To differentiate the goods or services provided by different traders, trademarks help. A third party is not allowed to use a registered trademark or similar marks on goods or services covered by the registration unless authorized by the trademark owner. Trademark registration is valid only on specific regional. For example, a trademark registered in Hong Kong is protected in Hong Kong only; and should be registered in another country if protection in that country is required.

Trademarks are graphical symbols made up of, for example, texts in different language, logos, personal names, alphabets, 3D object or combination of any of them. However, wording that is direct description or gives praise of the goods or services are ineligible for registration.

An application for trademark registration takes about six months to complete normally. The registration is valid for 10 years, and can be renewed upon expiry.

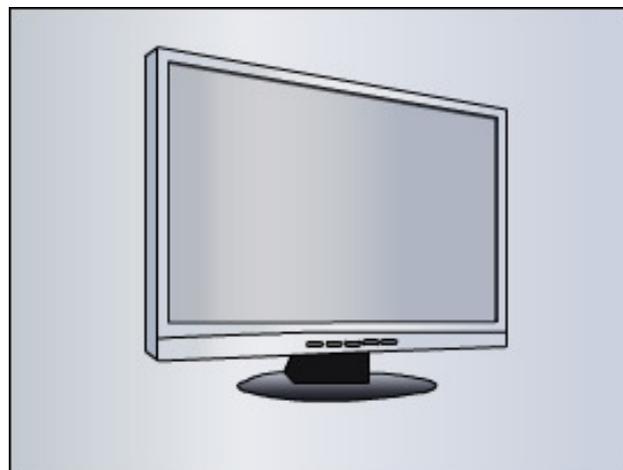


### 1.2.5 Registered Design

Generally speaking, a design refers to a new configuration, patterns, ornament shape that is applied to an article by an industrial process, and whose features appeal to and are judged by the eyes. A registered design is one registered and thus protected.

Only new designs are eligible for registration. A design is considered ineligible for registration, which is invalid even if registered, if it is disclosed to the public before filed for registration application. Fabric patterns, appearances of watches, jewellery, toys, mobile phones, etc can be registered.

Protection for a registered design is valid regionally. Therefore, registration has to be done in each region that protection is required. The valid period of a registration lasts from 5 to 25 years, depending on the country concerned. For example, currently a UK registered design lasts for 25 years, US 14 years; and PRC 10 years. The protection is valid as long as renewal fee is paid.

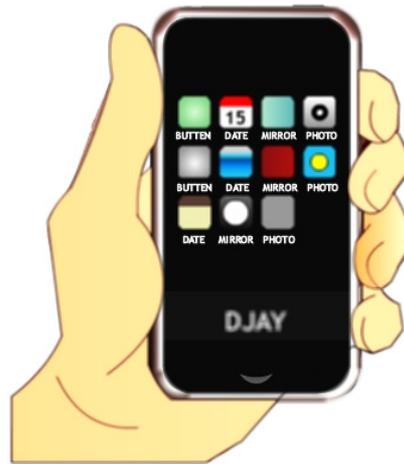


A Registered Plasma TV Design

### 1.2.6 Summary

What is the importance of intellectual property (IP) to evolution of civilization?  
 IP encourages innovation and creativity that lead to evolution of civilization.

There are four main types of IP illustrated with mobile phones as follows:



(a) Patents

The technical and functional aspects of the products and processes are protected by patents. For example, the working parts, the technical aspects of the control screen and the manufacturing process.

(b) Registered Designs

The visual appearance and eye appeal of products are protected by design registration such as the shape, form and appearance.

(c) Copyrights

Literature, art, music, sound recordings, films, broadcasts, etc are protected by copyright. Specific examples include ring tone, software, instruction manual and even sketches, technical drawing or models made during the development of a product.

(d) Trademarks

Signs which can distinguish the goods and services of one trader from another are protected by trademarks. For example the Apple logo and iPhone are trademarks of Apple Computer. Names or logos used on a mobile phone or a jingle used to advertise can all be protected by registered trademarks.

## S T O P   A N D   T H I N K

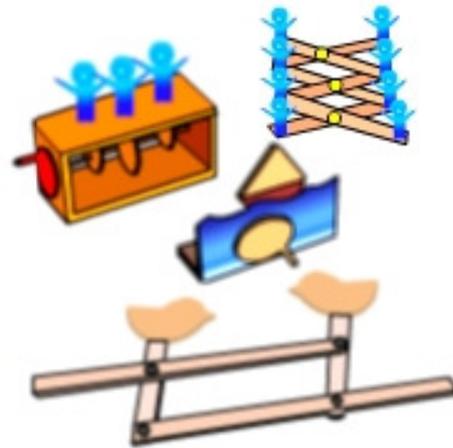
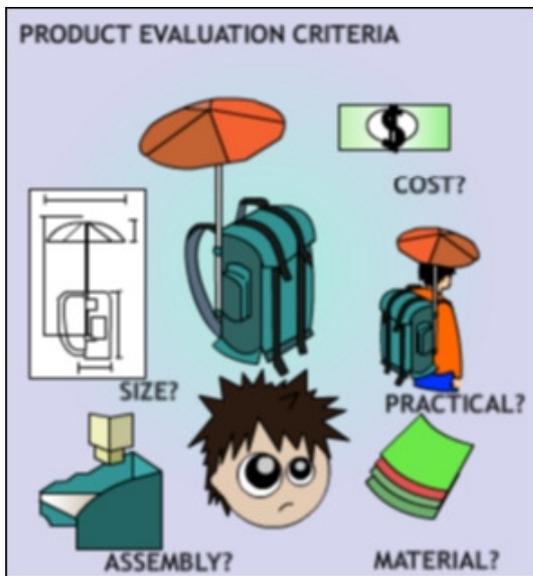
### **Case Study**

Describe how the design of a product in the market can be protected from unlawful duplication.

## 1.3 PRODUCT EVALUATION

The process that determines the quality of a product is called ‘product evaluation’. Such a process is of great importance throughout the product development cycle. Whether it is a comparison among existing products in the research stage, or a selection among potential concepts in the development stage, a proper evaluation is required for the decision making. The essential first step of the product evaluation process is the establishment of product evaluation criteria which will be explained in Section 1.3.4.

The cost of making changes increases as the product development cycle approaches its end. For this reason, such changes should be done as early as possible, so that impact on the project schedule, financial status of the project, etc can be minimized.



Regardless of size, products need evaluation

### 1.3.1 Presentation and Prototype

How a designer demonstrates her/ his proposals for product evaluation is very important, especially when the people involved in the evaluation may not be familiar with the drawing conventions that the designer uses. Ideally, product models should be shown as if they are already the real objects of the products.

Unfortunately, there is no free lunch. The costs of making a model or prototype normally increase as it is more close to a real product. The following are some trade-offs:



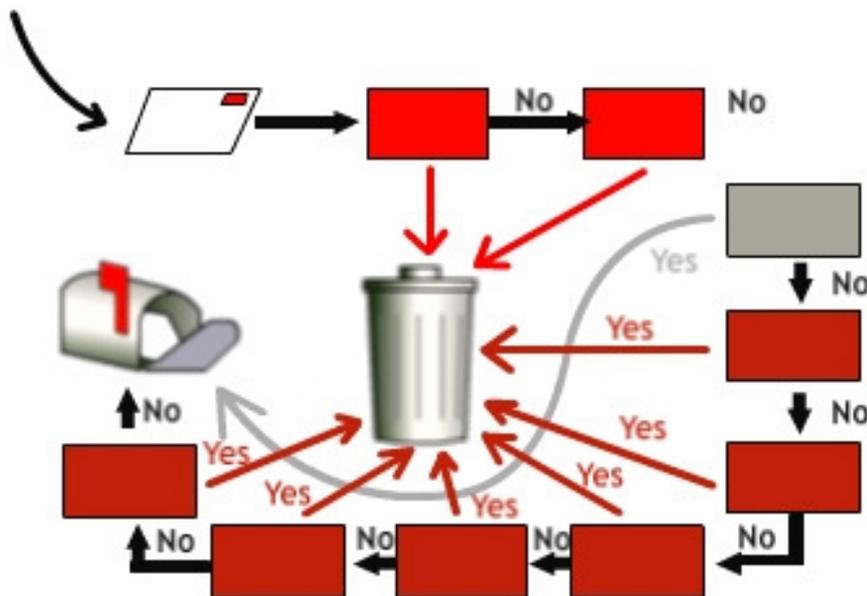
A design sketch

(a) Verbal Description

It is cheap and useful, especially when the operations and use of a product are presented. However, this method is not comprehensive.

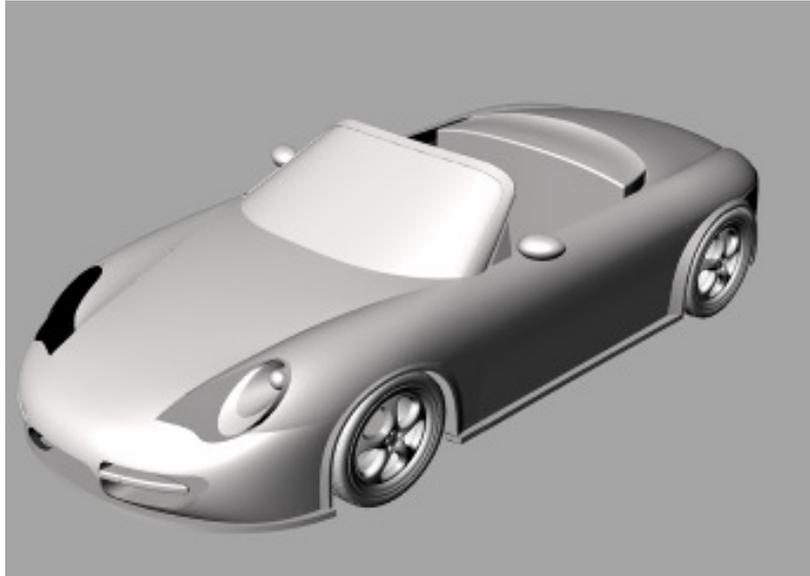
(b) Flowcharts

Flowcharts are good for presenting the operations of a product. However, some people may not understand the standard flowcharts.



(c) Realistic Illustrations on Paper or Screen

Computer-aided Design (CAD) software can show three dimensional coloured pictures, and also create details, such as material textures, light effects, shadows and mirroring on glass surfaces visible to audience.



3D CAD drawing

(d) Mock-ups

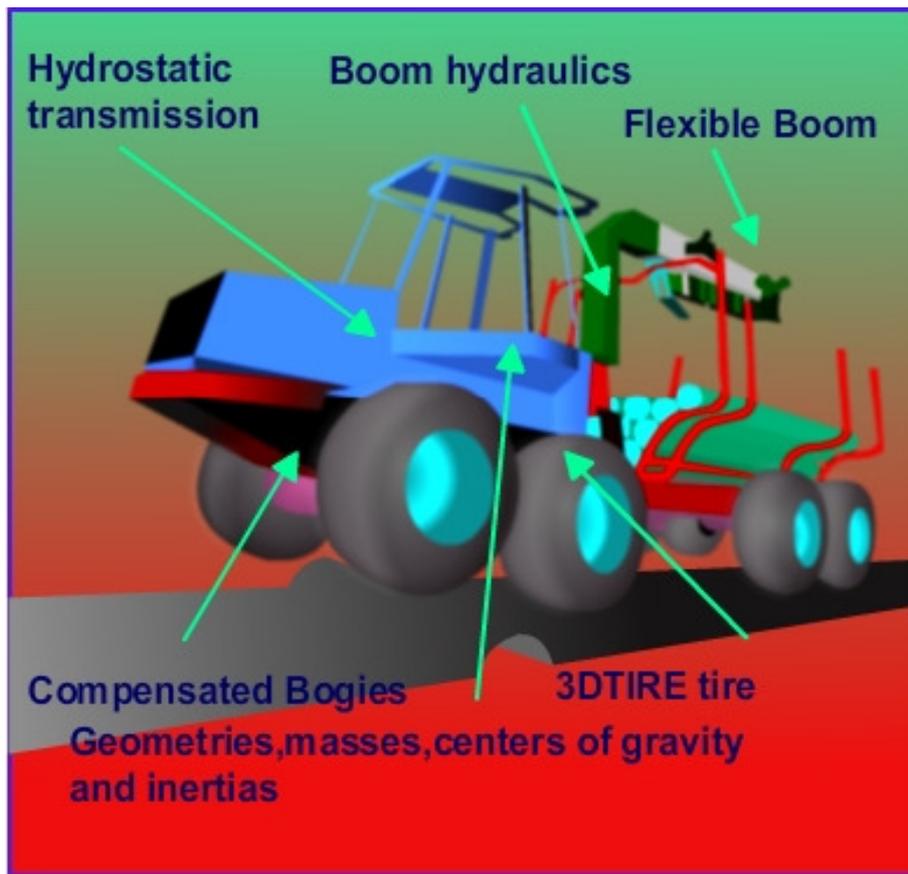
Actual 3 dimensional models made of paperboard or cardboard can help as well. In some cases, the models are built in actual scale. Such models sometimes are used as preliminary prototypes.



Materials to build 3D models

(e) Virtual Prototyping (VP)

VP enables animation, showing, for example, the operation of a product, in a computer screen. Computer software can even simulate the handling of product for immediate responses to the audience in an interactive mode.



3D virtual model showing the major parts of a Toy Truck

(f) Simulation

Simulation by CAD software can be used to simulate and evaluate the performance of a product or a component of a product. Quantitative and qualitative information of the performance, such as under a bending load, of the tested object can be collected through mathematical methods. Normally, Computer Aided Evaluation (CAE) is used to test the performance of a product or component using a CAD model through simulation; CAE, thus, enables engineers to analyse the test data so as to optimize the lowest material cost and product target performance.

(Reference: [www.vif.tugraz.at](http://www.vif.tugraz.at))

(g) Rapid Prototype (RP)

RP usually involves diverse technologies. It may transfer CAD data to physical modelling machines using stereo lithography and other materials, such as photopolymers, thermoplastic, waxes, and heat sensitive sheet materials.



The prototype of a game character

### 1.3.2 Points of View in Evaluation

The following parties are often involved in the evaluation of a product proposal:

1. Potential users,
2. Manufacturers and technologists,
3. Marketing people and organisations,
4. Outsiders, and
5. Schools or associations of professional designers

### 1.3.3 Evaluation Matrix

Evaluation or concept selection matrix is one of the most common decision tools in product development. It may also be used on customers for testing the product concepts and performance, as well as selecting the best design among alternatives.



Focus Group Study with school children

### 1.3.4 Methodology

1. Establish evaluation criteria
2. Prepare the evaluation matrix
3. Rate the concepts/products
4. Rank the concepts/products

The first step of the analysis is to make a table showing all important attributes of the proposals and their weights. The weights are set up when the desirable product attributes are first defined. As a basis, one may use the table for the product concept.

In case the evaluation criteria have drastic changes, re-constructing the table may be required.

For calculation's simplicity, product properties that are identical in all alternatives can be excluded from the evaluation.

It is a minimum requirement that each table should contain the following two columns for each to-be-evaluated proposal, namely

- (a) 'Utility', which may range from 0 to 5 for example, for the proposal's merits for each attribute; and
- (b) 'Weighted Score', which is product of 'Weight' and 'Utility'.

Finally, all products calculated have to be summed up on the bottom line. The best alternative is the one of the highest sum.

Product Attributes	Weighting W	Alternative 1		Alternative 2	
		Utility U	W x U	Utility U	W x U
Capacity	40	2	80	5	200
Ease of use	40	3	120	4	160
Design, appearance	10	5	50	2	20
Materials, recycling	10	3	30	2	20
<i>Total</i>	100	--	280	--	400

Specifications are established at the beginning of the design process. They do not necessarily cover every consideration and may be changed for various reasons. There may also be additional criteria, which are important to the design, such as

- (a) Aesthetics,
- (b) Ergonomics,
- (c) Functionality,
- (d) Materials, and
- (e) Usability.

The following are some questions that may facilitate the product design process:

Product Evaluation Criteria	Questions to Ask
Aesthetics	(a) Does the product look nice? (b) Is it well finished? (c) Is it appreciable to the target customers?
Available Resources	Are the materials, tools, machines and other necessary resources readily available?
Design for manufacturing	(a) Is the product easy to manufacture? (b) Is the manufacturing cost high?
Ergonomics	(a) Is the product comfortable for users? (b) Does the product fit the human users?
Ethics	(a) Are the material and processes involved environmental friendly? (b) Do the contents give negative influences on the target audiences?
Function	(a) What is the purpose of the product? (b) Does the product fit for its purpose?
Market Potential	(a) Will there be sufficient customers willing to buy this product? (b) Is it profitable for the company to produce this product?
Price / Cost	(a) Is the cost high or low compared with similar products in the markets? (b) Will the price be competitive in the market? (c) What is the unit cost of the product? (d) How will mass production affect the cost? (e) How many customers are willing to pay for the product?
Product life span	How long is the product expected to last for?
Quality	(a) Will the quality of the product be acceptable by the end users? (b) Does the product always perform as it should be? (c) Is it durable?
Safety	(a) Is the product safe to make, use, store, and dispose of? (b) Will the product pass all relevant product safety tests? (c) Will the design contain small parts that are dangerous to children?
Time	Will there be sufficient time for developing and implementing the solution?
Usability	(a) Who are the end users? (b) Is the product easy to use by the end users?

### 1.3.5 Techniques Related to Product Evaluation

A good product design is expected to keep the product's production cost as economic as possible. 'Performance-cost Comparison' is one of the many tools for verifying the above expectation. 'Value Analysis' can facilitate the reduction of the product cost in case the cost is considered higher than acceptable.

#### (a) Performance-cost Comparison

It is easy to obtain details of the performance of a group of similar products from the product specifications and compare these with their prices / costs. If the performances of two products are similar, the one with higher price / cost is inferior to the other one, hence, the former will be less competitive in the market. Cost reduction is necessary in order to improve its competitiveness. The following technique is useful for cost reduction and increasing performance / value.

#### (b) Value Analysis

The technique is to improve either the product quality or the production cost. It addresses the improvement of design at the research, design and production stages of product development. In addition to immediate and obvious cost reduction, it may bring along with other benefits, such as

- (i) Reduced complexity of the product;
- (ii) Standardization of components and parts; and
- (iii) Improvement of functional aspects of the product.

Value analysis is to improve a product by focusing on critical customer requirements in an optimal manner. In many cases, an effectively managed value analysis program can reduce production costs from 15% to 50%, without sacrificing the quality.

## S T O P   A N D   T H I N K

- (a) Describe what a product evaluation presentation will include.
- (b) Create an evaluation matrix for the 6-leg spider as shown below.



## 1.4 ENVIRONMENTAL RESPONSIBILITY

Sustainability requires the participation of all disciplines as well as all workforce levels, while legislation provides a bottom-line for environmental protection. Generally speaking, sustainable development has to balance three aspects, namely

- (a) Environmental protection,
- (b) Social responsibility, and
- (c) Economical responsibility.



Do not contaminate our beautiful environment

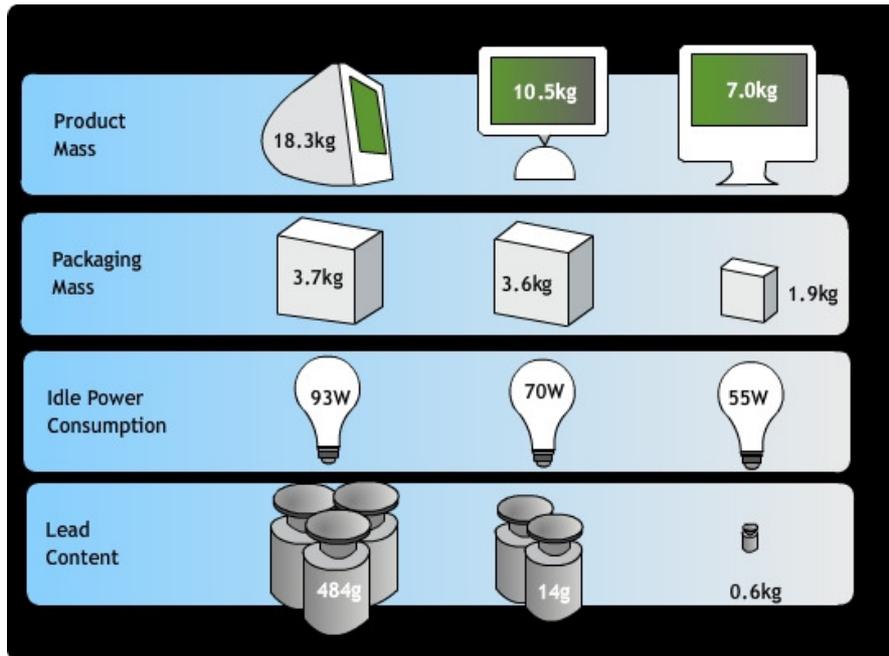
A proper design and using appropriate technology are the prerequisite for environmental protection. They are the frontline for minimizing, if not eliminating, the negative impact of a product on the environment. A proper design is expected:

- (a) Not to use hazardous substances,
- (b) To use as least materials and energy as possible, and
- (c) To minimize the impact on the environment when a product is disposed of.

### 1.4.1 Sustainable development

The balance of human needs and the natural environment protection is core of sustainable development. Sustainable development facilitates the continuous fulfilment of human needs of not only those in the present, but also in the indefinite future. This explains why designers and engineers have to put sustainable development in their agendas.

Designers and engineers have the responsibility to minimize, if not eliminate, the negative impact of their products on the environment. For example, the greenhouse effect, environmental pollution, atmospheric ozone layer depletion and unbalanced ecology.

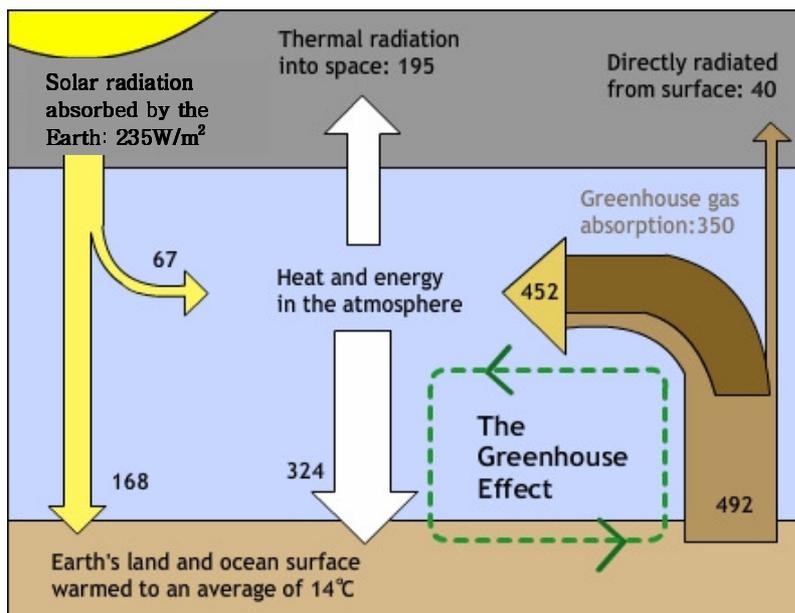


Engineers can improve environment by better designs

### 1.4.2 Sustainable development: Environmental Issues

Greenhouse effect is a result from the absorption of heat generated by greenhouse gases into the atmosphere, and the re-radiation downward of some of that heat.

The greenhouse gases ‘create’ a greenhouse to ‘trap’ heat in the lower atmosphere. The top concern of the present is the intensification of the greenhouse effect by human activities. As such, designers and engineers have to incorporate this concern into their product design, from the fabrication process, to the servicing time, or any stage of the life cycle. For example, environmental friendly engines can be designed and built for cars.



Greenhouse Effect

A schematic representation of the exchange of energies between outer space, earth's atmosphere and earth's surface is shown above. The greenhouse effect is characterized by the ability of the atmosphere to capture and recycle the energy emitted by the earth surface.

The release of chlorofluorocarbons (CFC's) from manufactured products leads to atmospheric ozone layer depletion. The depletion enables the arrival of more harmful ultraviolet (UV) radiation at the earth. Consequently, cataracts, skin cancers, suppressed immune systems in humans and reduction of yields of crops happen. To stop worsening the situation, CFC's are not (expected not to be) produced any more, and will (are expected to) eventually be eliminated from products.

Other environmental impacts include:

- (a) Noise generation,
- (b) Waste disposal, and
- (c) Environment-polluting by-products of manufacturing processes.

For noise pollution, both technologies and traditional methods, such as isolation and enclosure, can be used to keep it within the lawful limits.



Noise pollution and polluting gas emissions

There are environmental related legislations and directives, such as Restriction of use of Hazardous Substances (RoHS) and Waste Electrical and Electronic Equipment (WEEE), for materials and recycling purposes. Such requirements draw attention from designs, engineers, manufacturers and users to the wastes disposal issues and the importance of recyclable products. Waste disposal thus can be reduced.



Use recyclable materials



Use natural energy source



Developing a good user habit

## STOP AND THINK

Moon cake boxes have been criticized by people for their environmental unfriendliness. Suggest how the boxes can be designed to address the issue.

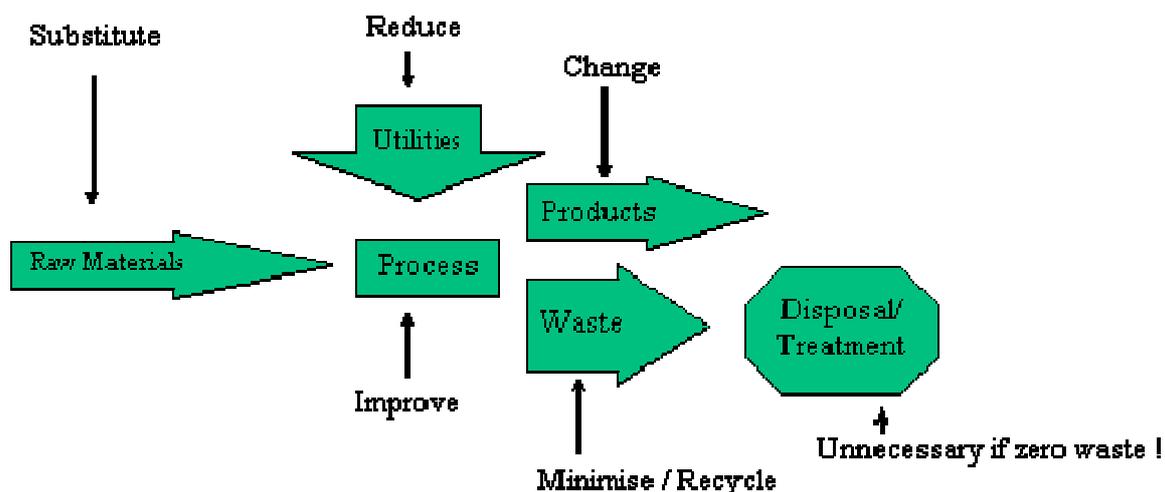


### 1.4.3 Sustainable development: Clean Technology

Due to legislative requirements, customers' and other pressures as well as the realization of the importance of sustainable development to the future, the business world is increasingly adopting clean technology. Clean technology includes

- Renewable energy, such as wind power, solar power, biomass, hydropower and biofuels;
- Information technology;
- Green transportation;
- Green electric motors;
- Right-intensity and power-saving lighting; and
- Many other appliances that are now more energy efficient.

Such technology is applicable to raw materials, utilities, process, products and wastes. Using renewable materials and energy sources are expected to help reduce wastes and minimizing, if not eliminating, emissions.



**Clean Technology opportunities can apply to all stages in the life cycle**

Electrical energy has facilitated economic growth and enhancement of living quality for human beings very much. Its generation by traditional fossil fuels however brings along with pollutants for the environment, such as air and water. Similarly, vehicle engines provide human beings, in addition to transportation convenience, with polluting gases through the chemical-mechanical energy conversion.

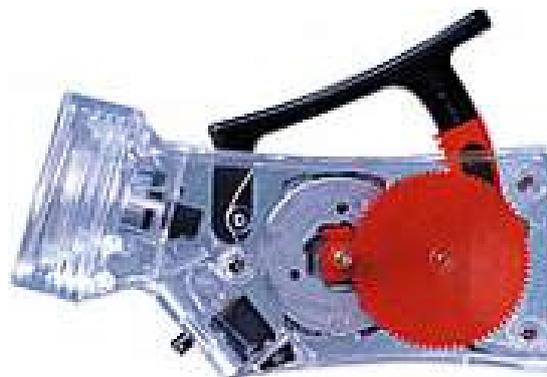
Clean technology seems to be an exit of such dilemmas: using wind power, solar power, hydropower, biofuels, etc to replace 'dirty' fuels, such as petroleum and coal. It should be however noted that clean technology may have its own limitations at the same time. For example, the power and energy generated from batteries are considered 'clean'. The disposal of batteries creates environmental-unfriendly wastes.



Clean Technology for clean energy

**S T O P   A N D   T H I N K**

Discuss whether a motion light torch is a cleaner technology than a battery light torch.



**1.4.4 Sustainable development: Green Design**

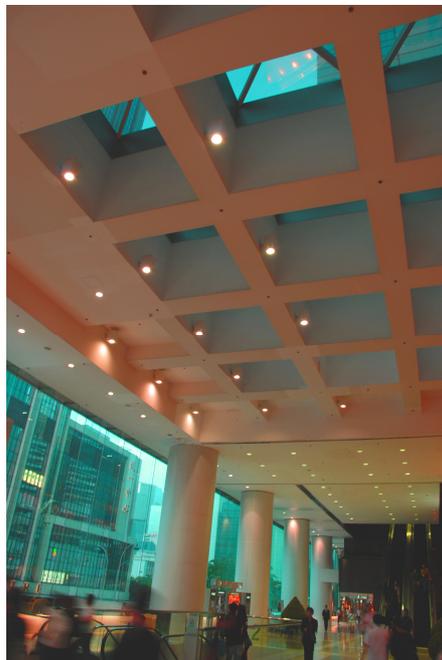
Green design, ‘eco-design’ and ‘design for environment’ all refer to the incorporation of the principles of economic, social and ecological sustainability into designing physical objects. Green design covers as small objects as those daily necessities, and as large objects as buildings, cities and the earth’s physical surface. In the architecture sector, green design is already an irreversible trend, no matter whether it is landscape architecture, engineering, graphic design, industrial design, interior design or fashion design.



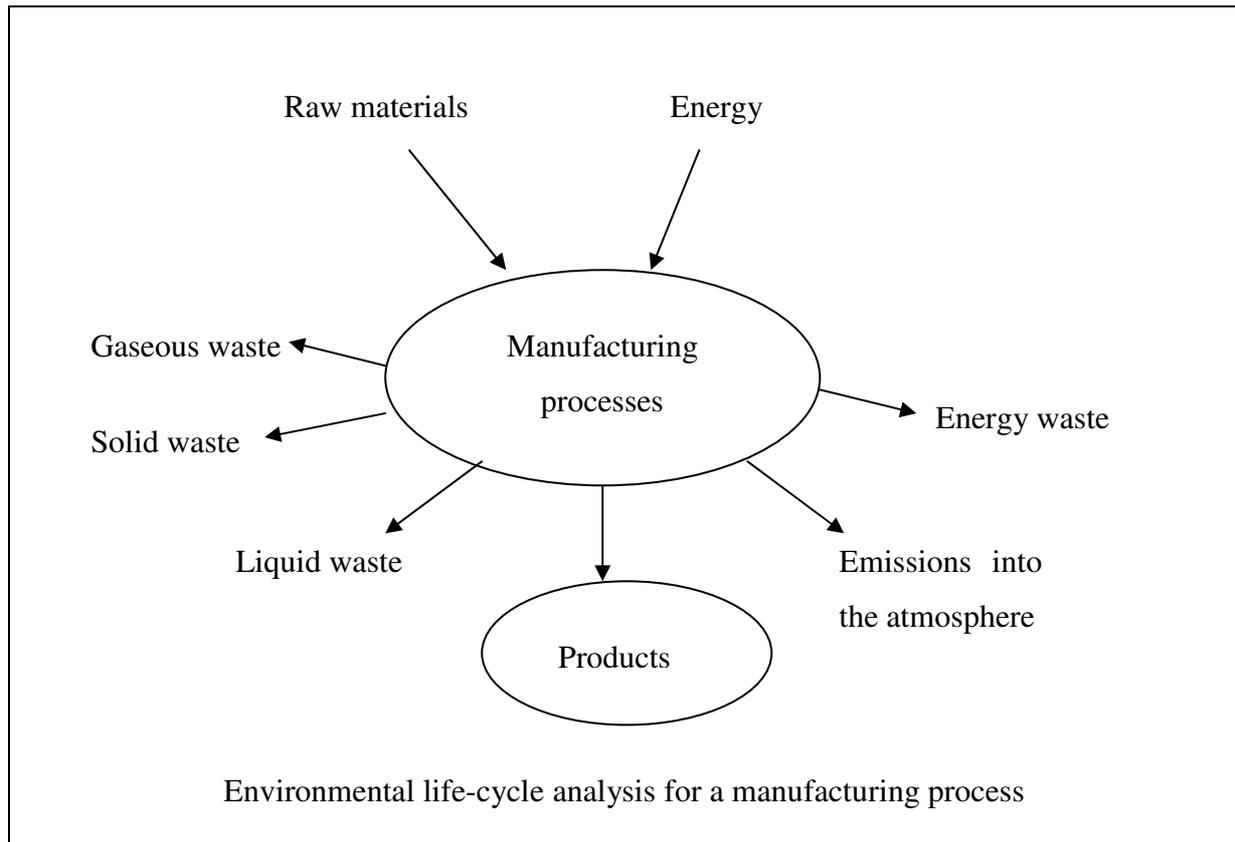
Eco-design bags – bio-decomposable material

The most important goal of green design is to produce environmental friendly products or services. In other words, the products or services are expected to use less non-renewable resources, create minimal environmental impact and re-establish the relationship between people and the natural environment.

Sustainable design on the other hand is considered necessary for achieving sustainability. It is more heavy industry-oriented and associated primarily with fields of, for example, industrial ecology and green chemistry. Life cycle assessment and life cycle energy analysis are generally used to evaluate the environmental impact or 'greenness' among different design choices.



Eco office – use of sun light



### D O T H E R I G H T T H I N G

- (a) Why should products be recyclable?
- (b) What damages can be made to the earth if designers and engineers do not pay attention to environmental issues?
- (c) Can home appliances be replaced by environmental friendly ones?

## 1.5 APPROPRIATE TECHNOLOGY

Most, if not all, manufacturers want to produce more competitive products and gain a larger market share. To do so, manufacturers have to manage different uncertainties, such as ever-fluctuating demands and, perhaps more importantly, the use of appropriate technology. For designers and engineers, they can help the manufacturers by choosing appropriate technologies for producing winning products.

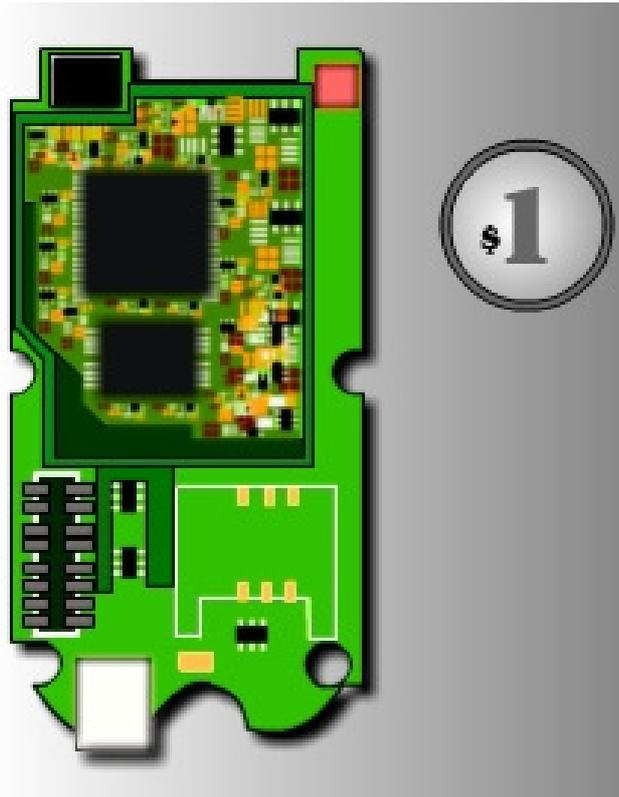
### 1.5.1 Appropriate technology and resources

The ‘appropriateness’ of a technology is defined as the technology’s appropriateness to the environmental, cultural and economic situation that the technology targets at. As such, an appropriate technology is normally using fewer resources, incurring lower costs and creating lesser adverse impact on the environment. Very often, an appropriate technology is considered that the most minimal level of technology that can achieve the intended purpose effectively.



Bamboo scaffolding used in buildings

A common example of using appropriate technology is the employment of integrated circuits (IC's) in printed circuit boards (PCB's) to replace discrete components. IC's make the manufactured products safer, use fewer materials, incur lower costs and be more environmental friendly. This illustrates how simplicity, environmental friendliness and economic situation are achieved simultaneously.



PCB for a variety of technology applications

People might argue that ‘appropriate technology’ for a technologically advanced society implies a more expensive and complicated technology.

How products can be manufactured time-to-market and at the lowest possible cost for competitive pricing in the market is a never-ending concern for manufacturers. Good news is that there are increasingly sophisticated software tools enhancing the production process. Also good news is that there are new information technologies facilitating communication among customers, designers and engineers, and manufacturers.

Surviving in a market is never an easy task, not to mention to gaining a desired market share. Manufacturers and product designers have to evaluate all factors that attributes to the success of a manufactured product, balancing various criteria carefully. Furthermore, they should be capable of making decisions on what, how and when to incorporate appropriate technologies to the manufacturing process of a product.

Actually, there are other considerations than just choosing appropriate materials and technology for designing and building a product. Manufacturers and product designers have to observe different elements, such as environment, safety, energy and, very importantly, social responsibility over the product development cycle.

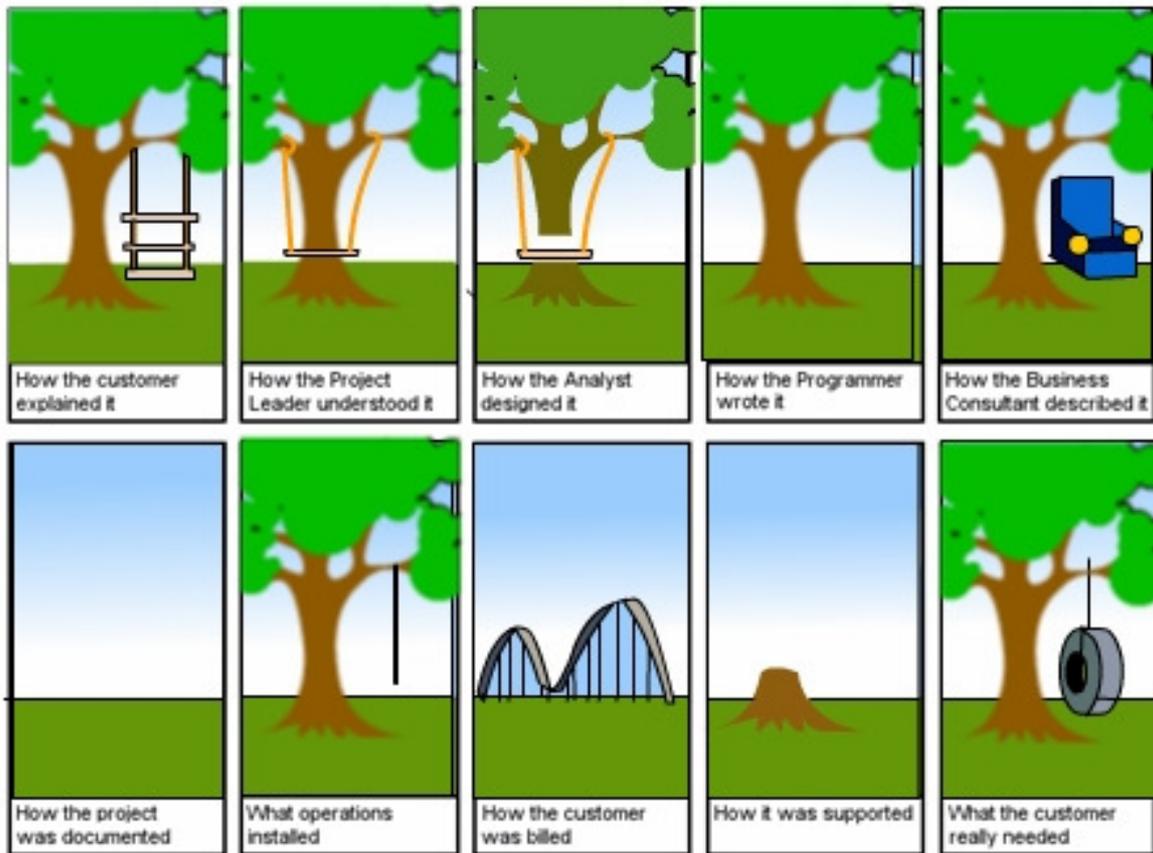
**S T O P   A N D   T H I N K****Case Study**

Explain why Tsing Ma Bridge uses the much more expensive induction lamps instead of those of lower costs.

**1.5.2 Balancing criteria and exercising value judgment**

Due to different opinions and conflicting interests on a product, it is not unusual that stakeholders engage in heated debates or even confrontations. For the success of a product, stakeholders' needs have to be balanced and compromises on certain aspects, if required. For example, wholesalers and distributors want to have the lightest, smallest and most powerful laptops as quickly as possible for sales. But the suppliers and developers need time to design, develop and build the computers.

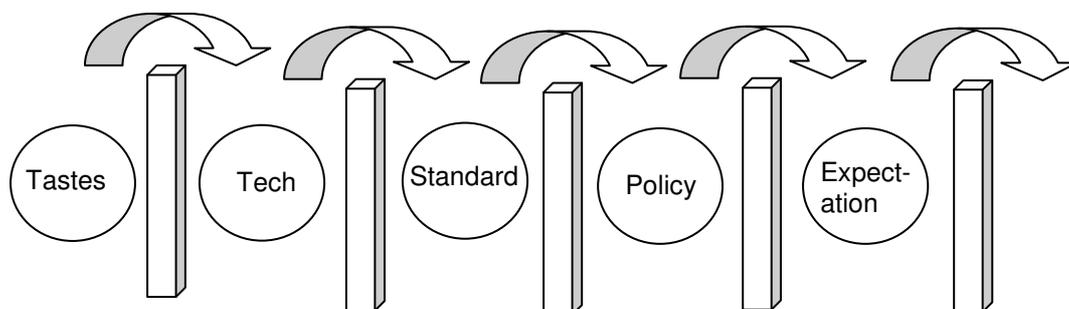
The success or value of a manufactured product can be often summarized by some determining key factors, namely fit for purpose, easy and comfortable to use, affordable, stylish, reliable, low cost, safe to use and cause no damage to the environment.



An ideal design product: fit for purpose, easy and comfortable to use, affordable, reliable, low cost, safe to use, and environmental friendly

In order to maintain the position of a product in the market, manufacturers have to keep analysing and evaluating their products. Analysis and evaluation are important because they can reveal:

- (a) Change of customer tastes;
- (b) Change of product over time as new technology or materials develop;
- (c) Change of product standards, especially safety standards;
- (d) Change of regulations; and
- (e) Change of expectations on the existing products.



Time changes the requirements on products

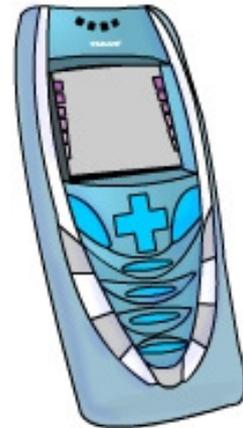
Some example of consumer products that require frequent analysis and evaluation are shown as follows:



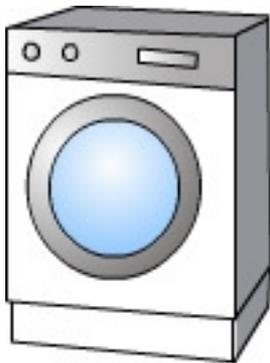
Digital Cameras



Fitness Bike



Mobile Phones



Washing Machines



Toys



Navigation Systems

## S T O P   A N D   T H I N K

### Case Study

What are the conflicting interests and benefits of the stakeholders, such as clients (or users), wholesaler/distributors, material suppliers, designers and manufacturers?

**S T O P   A N D   T H I N K****Case Studies**

Focus on Problems vs. Focus on Solutions

Case 1

'Empty soap box' is a classic management case. It happened in very large cosmetics companies.

One day, a consumer complained that the box of soap he bought was empty. The authorities of the company immediately isolated the problem to the assembly line. During the manufacturing process, the assembly line was responsible for transporting all packed boxes of soap to the delivery department. For some reason, one of the many soap boxes went through the assembly line was empty.

Management asked the engineers to solve the problem. The engineers worked hard and hurried to devise an X-ray machine for monitoring. Under this setting, two persons had to be assigned to monitor all soap boxes that passed through the line, ensuring the boxes were not empty. Sure enough, it was a very labour intensive and time demanding task.

When the same problem was faced by a small company, the situation went differently. The company had no complicated methods, such as X-rays. Instead, the company placed a strong industrial electric fan at a point of the assembly line, letting those empty, light-in-weight boxes blown away. The fan is an appropriate technology in this case.

Moral of the story is Keep It Simple, Stupid (KISS). Do look for simple solutions, and devise the simplest possible solution that solves the problem.

Case 2

It came from attention of the National Aeronautics and Space Administration (NASA) that pens did not work in space since ink did not flow down to the writing surface under zero gravity. NASA thus spent a decade and USD12 million to develop a pen that could write under different environments and situations, such as zero gravity, upside down, underwater, from below freezing to over 300°C, and even crystal surface.

What did Russians do with the same problem? A pencil - an appropriate technology for the solution.

## CHAPTER 2 – HISTORICAL AND CULTURAL INFLUENCES

This chapter covers topics on:

- (a) Evolution of Craft and Design
- (b) Design and Culture
- (c) New Technology

These topics include learning materials and activities that facilitate the students to:

- (i) Understand the development of craft and production technology;
- (ii) Understand the impact of design on culture; and
- (iii) Understand the impact of new technologies on the quality of life.

## 2.1 EVOLUTION OF CRAFT AND DESIGN

Evolution and advancement of design never stops. Design makes people's dreams come true. Among others, craft and design has long been part of human's history. Its development can be divided into five important periods, namely

- (a) Application of Natural Resources,
- (b) Spread of Publishing Techniques,
- (c) Steam power and Industrial Revolution,
- (d) Electricity and Modern World, and
- (e) Computer and Information.

### 2.1.1 Origin and purpose of design activities

'Design' is a multi-discipline process, combining art, operations and technology. Its coverage extends from drawing and planning, to making, selling and using of manufactured products, and to engineering, etc.

In fact, design is a problem-solving activity. The problem that a designer faces is the various propositions. The solution to be sought is a so-called best option, which is a design that balances as many factors as possible.

Design is a creative activity for deriving a proposal that normally cannot be done by a deductive analytical process. Generally speaking, a designer has to consider many factors, such as working context, time, cost, materials, his own knowledge and the clients' needs. Specifically, a product designer, for example, has to consider the price of design compared with manufacturing cost.

To ensure the value and usefulness of a solution or a product, its design has to be lively and its designer has to be open and alert to different situations, circumstances and opportunities. A design, especially those very large design projects, may be contributed by a team instead of an individual. This explains why team work, an evergreen management topic, among co-designers and other team members are of utmost importance.

As mentioned above, there are different periods of design activities before the modern age.

- (a) Application of Natural Resources

Human beings knew how to make knives and axes with stone as early as two million years ago; and they started making fire from wood afterwards. As technology developed, people gradually formed villages, cities and countries, and became civilized. It is a period that human beings fully utilized their knowledge and natural resources, building a good foundation for further technology development.



Stone arrow head



Stone-made tool

### (b) Spread of Publishing Techniques

The first movable-type printing machine was invented in around 1450 AD. This invention opened the chapter of mass replication of books, more importantly, the wide exchange of knowledge. Since then, knowledge of natural science, medical, engineering, mineral extraction, metal refining spread, and techniques were improved. It built up beneficial conditions for technology's further development.



Printing machine

### (c) Steam Power and Industrial Revolution

The invention of steam-driving water pumps in 1712 marked the beginning of a new mechanical era. Since then, people started making use of man designed power instead of depending solely on natural power, such as man or wind. 'Industrial Revolution', a famous term that perhaps nobody does not know, was named for this change that had great impact on the industrial production.



Steam powered train

(d) Electricity and Modern World

Electricity emerged in the 1870's. It has completely modernized the world and enhanced human beings' living quality. With electricity, various electrical appliances, such as air-conditioners, computers, televisions and cookers, were invented.

(e) Computer and Information

John Bardeen and Walter Brattain invented transistors in 1947. Transistors replaced electrical vacuum tubes, which were expensive in monetary terms and bulky in volume. Transistors were subsequently replaced by integrated circuits (IC's), which were invented in 1971 and provided more complicated and multiple functions. The development of computers thanks to the introduction of IC's.

Computer's capabilities play a key role in technology development of the recent decades. Various fields, including but not limited to communication, medicine, entertainment, scientific research, transportation, rely on computers. Especially, the Internet has speeded up and enlarged the extent of information spread, and announced the beginning of the information era.

### 2.1.2 Design movement

People from different cultures have different abilities to make tools and to communicate. The evolution in art, design and technology has great impact on civilization. Many individuals, civilizations and cultures have contributed their own value to the collective knowledge, skills and understanding through the centuries.

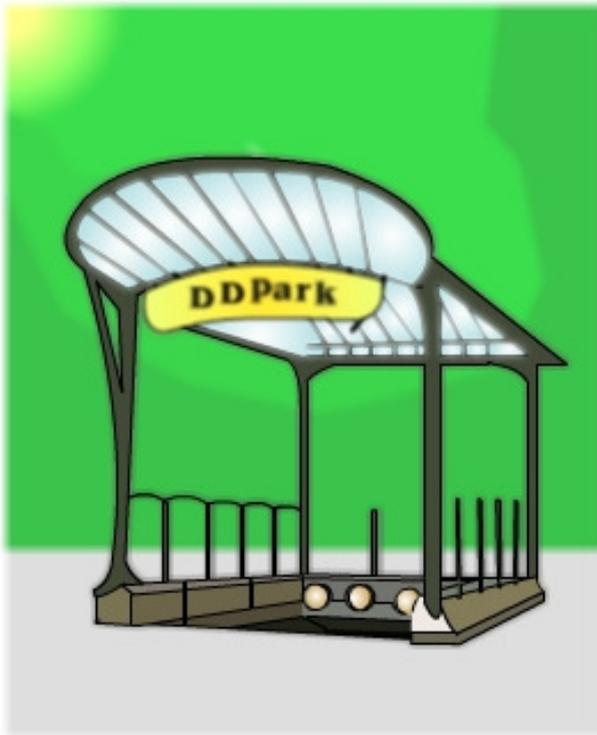
Design movement refers to a common or similar design style that is shared among some artists or designers. The period concerned may last for months, years or decades. While style or aesthetics is only perhaps a matter of personal or even generational taste, some major aesthetic styles do have long impact on product design and architecture since the late 1800's.

The Chinese, Egyptians, North American Indians and Romans created their own artifacts and environments on their own lifestyles and beliefs and by the materials and processes that they then had. Their works dominated the art, design and technology movements in the early centuries.

The Victorians did not ask for uniformity. Many of their key developments built the foundation of the Industrial Revolution. For example, the art and architecture then shaped the growth of large cities; steam and gas powered the railways and trams.

The design style of Art Nouveau is based on natural shapes. Patterns and designs of the style are often curving, intertwined plant and animal shapes. Some examples are climbing vines

and flowers, leaves, birds, insects and women with flowing hair. Particularly, Louis Comfort Tiffany's stained-glass windows and lamps are major representatives of the Art Nouveau style. Art Nouveau began in the early 1880's and lasted until the beginning of the 1900's.



This entrance is a beautiful example of Art Nouveau style



An armchair in Arts and Crafts style

(a) Arts and Crafts Movement

William Morris was an English poet, artist, and socialist reformer, who rejected the opulence on the Victorian era and urged a return to medieval traditions of design, craftsmanship, and community in 1883. In this period, factory manufactured goods were often poor in design and quality. Morris proposed that it would be better for all if individual craftsmanship could be revived:- the worker could then produce beautiful objects that exhibited the result of fine craftsmanship, as opposed to the shoddy products of mass production. In his political writings, Morris attempted to correct the dehumanizing effects of the Industrial Revolution by proposing a form of society in which people could enjoy craftsmanship and simplicity of expression.

However, in time the English Arts and Crafts movement came to stress craftsmanship at the expense of mass market pricing. The result was exquisitely made and decorated pieces that could only be afforded by the very wealthy.

(Reference: [www.wikipedia.org](http://www.wikipedia.org))

## (b) Bauhaus

A school of design in Weimar, Germany, called Bauhaus, was founded in 1919 and ended up with political forced close down by Nazi party in July 1933. Bauhaus had profound influence upon subsequent developments in art, architecture, graphic design, interior design, industrial design and typography in 20th Century. The 1st headmaster was a renowned architect Walter Gropius (1919~28). He was convinced that the base for any art was to be found in handcraft. He developed new teaching methods: artists and craftsmen directed classes and production together at the Bauhaus; this was intended to remove any distinction between fine arts and applied arts. Being deeply influenced by Russian Constructivism (1917~1922) which had been inspired by Marxism art & cultural development theory in socialism, Bauhaus highlighted the radically simplified forms, the rationality and functionality, and the idea that design for mass-production to benefit all social classes. It was reconcilable with the individual artistic spirit that led to the birth of Modernism of 30's. One of the basic aims of this school of design was the design of affordable products that suitable for machine and mass production. The phrase "form follows function" has come to be associated with the Bauhaus, because the designs that emerged were very functional and honestly reflected the materials from which they were made. Materials were not disguised but instead became a statement about the product itself. In short, one of the key objectives of the Bauhaus was to unify art, craft, and technology with highest concern of social classification fairness. It stressed good design is not only serving for the wealthy upper class capitalist with limited produced product in high price but also for the lower working classes with mass produced product in affordable price.

Nazi party and other right-wing political groups had opposed the Bauhaus and criticized its modernist styles throughout the 1920s. They considered it a front for communists, especially because many Russian artists were involved with it.

Since the 2nd Bauhaus headmaster Hannes Meyer advocated his idealistic communist thought and encouraged some teachers and students to involve political activities in 1928~30, Nazi Party closed down the Bauhaus in Dessau when Adolf Hitler became German dictator in Oct 1932. Finally, Gestapo occupied Bauhaus in Berlin on 11 April, 1933. The 3rd Bauhaus headmaster Mies Rohe had to declare the close down officially in July, 1933.

(Reference: [www.wikipedia.org](http://www.wikipedia.org))



The Barcelona chair by Mies Van der Rohe is a classic example of Bauhaus “form follows function” design style

(c) Modernism

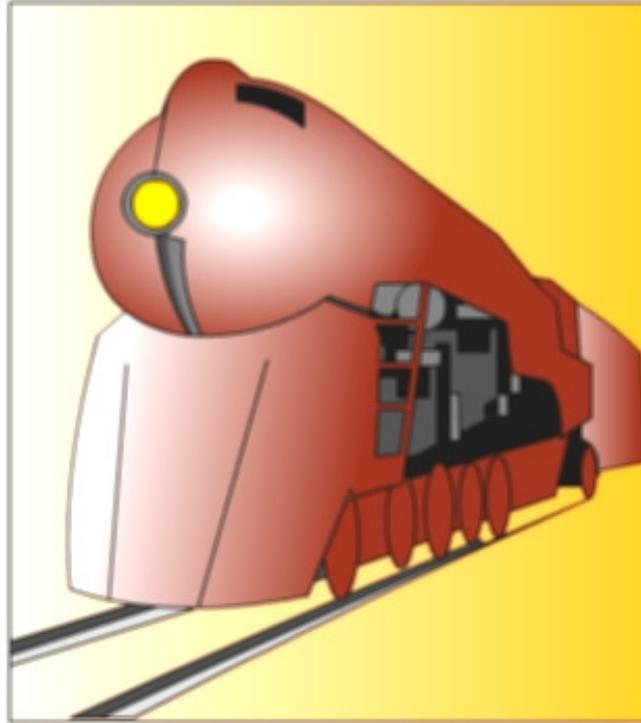
Modernism refers to the cultural movements developed from the changes in Western society between the late 19th and early 20th centuries. There was a series of reforming movements in art, architecture, music, literature and the applied arts.

Modernism recognized people’s abilities in creating, improving, and reshaping their environment with the help of science, technology and experiments. Modernism promoted re-examining every aspect of existence, no matter whether it is commerce or philosophy. Upon identifying any show stoppers or deficiencies, one has to replace them.

In the 1930’s when the Great Depression was just over, the modern design movement in Europe reached the United States. Modernism became an integral part of the US’s economy recovery plan. The Chrysler building in New York City, streamlined trains, jukeboxes and classic American diners, etc were results of Modernism’s futuristic style, which looked toward tomorrow.

The introduction of many new materials in the early part of the 20th century was considered one of Modernism’s important influences. Materials of Bakelite, nylon, Plexiglas, plywood, urea formaldehyde, vinyl, etc have impacted on design largely. At the same time, two influencing ‘partners’ of design for decades built their names: fluorescent lighting was introduced and neon became popular.

(Reference: [www.wikipedia.org](http://www.wikipedia.org))



A streamlined locomotive designed by Henry Dreyfuss

(d) Design in the 1950s and 1960s

A major characteristic of the designs during the 1950's and 1960's is perhaps the fullness of contradictions among the designs. Therefore, it is difficult for one to characterize or generalize them. When Henry Dreyfuss was working hard on human factors engineering, automobile manufacturers in Detroit were designing cars hard. At the same time, the US society was working hard on product production and selling for the economy. Behind the scene, there was still a significant functionalist movement in design.

Functionalism is a design of minimization and optimization. As society became rich, the demand on new products was strong from the 1950's to 1970's. People believed that new products were good products, which should be purchased regardless of whether or not the old ones still worked well.

(e) Contemporary High-Tech Design

Since the 1970's, a slick, clean look with flowing curves and sharp edges has become a trend in design. 'High Tech designs' externalize, and thus emphasize, the technical elements of buildings as the buildings' aesthetic. It is different from the hiding approach in the old days. The Hong Kong and Shanghai Banking Corporation Limited's (HSBC's) headquarters in Central, Hong Kong is a typical example.

The 1980's was an age of convenience products. Since the 1990's, environment friendly products started being the mainstream. Designers, or the public to be exact, are increasingly concerned about the green topic. Their designs inclined to use as few materials as possible for conserving natural resources and reduction of waste, and among those necessary, use as many environmentally safe materials as possible. New products were born in the 'Green Revolution', with which more products are expected to be born. For example, soy ink has been invented for printed products.



An example of High-Tech style: the HSBC building designed by Norman Foster

## S T O P   A N D   T H I N K

- (a) Describe how the ancient China's four inventions, i.e. compasses, paper, printing technology and gunpowder influenced the development of craft and design.
- (b) Explain which stage of the long technology history has the greatest impact on the evolution of craft and design.

## 2.2 DESIGN AND CULTURE

Culture is a collective lifestyle of a group of people of a particular space and time. Culture may be reflected in cloths, tools, any objects related to those people's daily life.

Cultural background is a building of idea generation: individuals of different cultural, family, academic, etc backgrounds generating their own ideas with respect to different contexts. Therefore, a unique idea is often a hybrid of diverse culinary ingredients and methods of preparation.

### 2.2.1 Relevance and Influence of Design in Different Cultures and Societies

Good designs and systems are everlasting. Therefore scholars and related practitioners examine them in depth to extract the essences, which are generic principles that may be applicable to other areas, instead of duplication. For example, the Ming-style 'horseshoe' is more than a museum collection. It hints some ergonomic principles.

How people process information that they learn from the surrounding is another reflection of different cultures. Studies show that people of western cultures pay attention to different things from those of eastern cultures.



Culture in East Asia



Western culture



Chinese Painting



Western Painting

For example, in the area of design, eastern cultures focus more on the contextual elements that work together to build the design. Western cultures incline to focus on an object.

With the role of culture in mind, designers can absorb, embrace and take advantage of different cultural values, modern design opportunities and technologies. Particularly in a highly globalized age that we are living on today, understanding the interdependence between design and culture is no more than a basic requirement for entering into the market.

Change is nothing new to the market. Its acceleration keeps pushing products to incorporate new ideas and lead the market. John Heskett considered design's historical developments a foundation of future designs: 'the evolution of a new stage of design does not entirely replace what has gone before, but, instead, is layered over the old.' New designs are evolved but not revolutionized from earlier ones, inheriting from the culture, tradition and history. It is a matter of continuity.

Globalization is distribution of products and services globally on one hand, and fusion of multicultural audiences on the other. What adjustments should be done for globalization then? 'Any good design requires some sympathy with the culture in which the device will be used,' said Genevieve Bell, an Intel social scientist who studies how cultures make sense of technology.

### **2.2.2 Designs Done by Different Cultures and Societies**

As mentioned before, social culture, economic, technologies, etc affect the development of industrial design. It implies that design styles vary from nation to nation, from region to region. How the design styles of the US, Europe, Asia, etc are different then? The following tell.

#### **(a) The US Design**

The demands for goods in the US increased greatly after the World War II. It resulted from after the booming of the US's economy, intensified by Consumerism or the 'throw-away culture', which itself was also a result of the booming of the US's economy. The people then believed that new products were good products; new look was fun; and throwing away broken goods was cheaper than repairing.

At the same time, the rise of professional industrial designers and stars, such as Raymond Loewy, Henry Dreyfuss, Walter Dorwin Teague and Norman bel Geddes, led to a rapid increase in demand for consumer products of radios, vacuum cleaners and refrigerators, etc. As the trend of professional industrial design developed, marketing and commercial opportunities arose. Businessmen added value to their products with style, and used their products to promote their companies.

The US design style was and is considered a kind of material excessiveness. There has been no dominated school of thoughts; but in recent years, environmental conservation and ergonomics are two popular topics.

#### (b) European Design

Industrial design was heavily affected by European culture, economic and technological development in the old days. Germany's Bauhaus, which impacted the development of modern design theories and education, is a great example.

European designs tend to be more functional, rational and pragmatic than its US's counterparts, which are consumerism and market force based. Having said that, there are different camps in the European continent.

#### (c) German Design

The great destruction from the World War I led German designers to develop the so-called Bauhaus ideology. In 1919, one year after WWI, the Bauhaus was born in Weimar, marking the beginning of modernism in the industrial design. The Bauhaus revolutionized the ways of designs of as small as a pen and as large as an airplane.

German design is well known for its good product engineering and reliability. It inherits from functionalism, i.e. clean line as well as black and white in colour.



A German design – BMW X3

#### (d) Italian Design

Italian designs are commonly considered sensational, speculative, experimental and sometimes very artistic. Many Italy's industries are small family-run, creating a culture of manufacturing flexibility and highly skilled workshops. Italian famous products include fashion, sport cars, interior lightings and furniture.



An Italian design - Enzo Ferrari sports car

## (e) Scandinavian design

Scandinavian countries are very stable and well developed economies after the World War II. These countries have a long history of putting people and society first in their designs, which are called Humane style. Ergonomics is an example.



A Scandinavian design – Nokia 6300 mobile phone

## (f) Japanese Design

Industrial design has been developed late in Asia. After the World War II, Japan developed its industrial design in the fastest pace among its Asian counterparts. Japanese designs today enjoy prestigious status in the international market. Its rapid growth results from the following:

- (i) The close relationship with the US after the WW II has facilitated the country's rapid economic growth. Japan's concentration on economic development has led the country to become an economic giant. Corporations like Sony, Panasonic, Toyota, Honda and NEC have become global players. Their products have strong influence all over the world.
- (ii) Japan's cultural tradition emphasized on the team play rather than the individual. People thus emphasize more the company's name than the designer's.
- (iii) Japanese turn their limitations in space into space-conscious designs, which are more pragmatic.
- (iv) Japanese products' innovation, design, production quality, product reliability, pricing, service and delivery have all been leading the American and European industries in the past three decades.



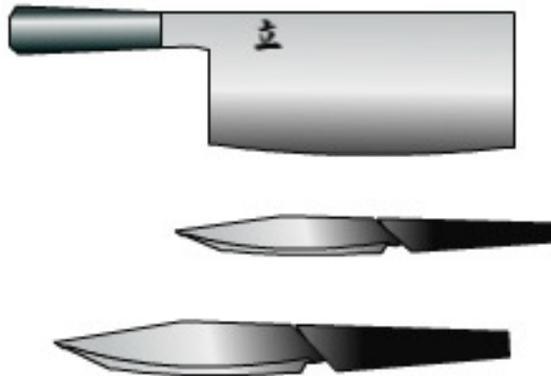
A Japanese design – Sony PlayStation 2

## S T O P   A N D   T H I N K

- (a) Describe the major differences in the design of sport wear and accessories, such as cycling helmets, eyeglasses and swimsuits between the Chinese and the European markets.
- (b) Comment on the two Barbie designs, i.e. Western and Arab.



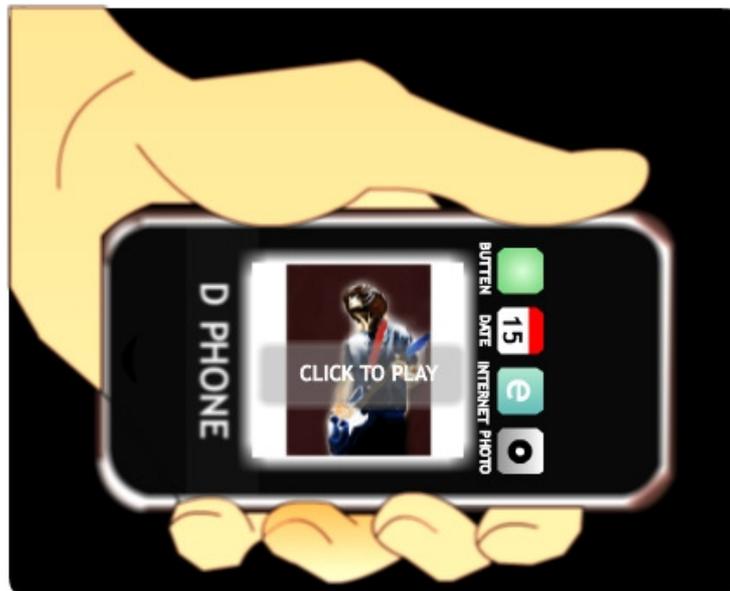
- (c) Describe the major differences in the design of a domestic kitchen knife between the Chinese and the European markets. Are they 'Forms Follow Functions'?



## 2.3 NEW TECHNOLOGY

Due to the continuous research and development, scientists and engineers have kept giving birth to new and emerging technologies over the last century. The emerging technologies under the spotlight in recent years include nanotechnology, miniaturization, green manufacturing and engineering. Such technologies, together with new materials, have been applied to different manufacturing processes and, hence, have affected people's daily life.

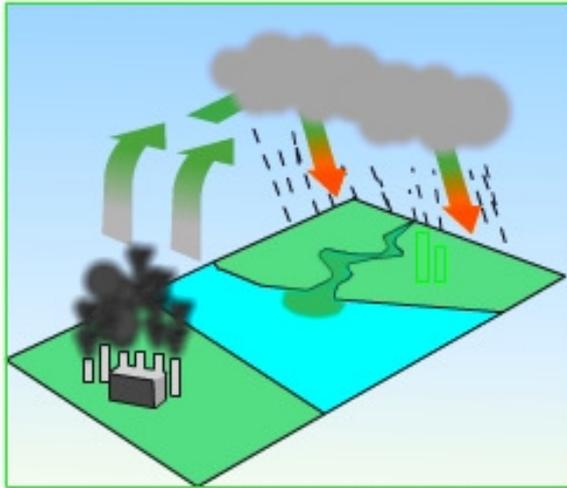
A typical recent example is iPhone. It consolidates the latest micro-chip, software, Internet, wireless, miniaturization technologies into a palm-size device that enables multiple services, such as telephony, email, SMS, television, data/ message upload/ download, business transactions and entertainment.



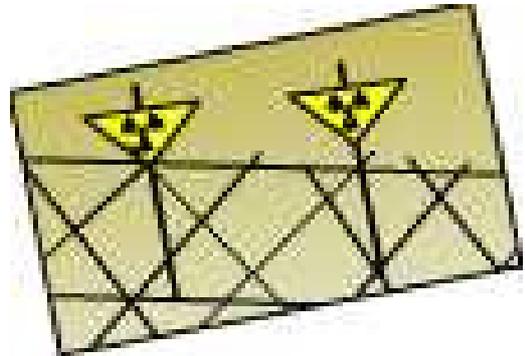
### 2.3.1 Impact of new technologies on quality of life

Engineering and manufacturing produces by-products apart from their contributions to public. For example, acid rain, greenhouse effect and disposal of damaging agents etc are still giving a headache to society. These problems urge researchers for developing clean designs that can enhance the positive impact on one hand and minimize the negative on the other.

It is already a problem to many big cities that the air quality is deteriorating in recent years. Pollutants come mainly from power generation, automobiles and factories.



Formation of acid rain



Dumping of damaging agent

Currently, about 90 percent of the energy consumed in the world is generated from fossil fuel. Up to this moment, the largest opportunity for environmental improvement in the aspect of power generation is high-efficiency-low-emission combustion engines. People are investigating how fuels can be converted into energy with as few pollutants created as possible. This is the area that new technology and engineering knowledge can help.

Fossil fuels release minute particles, CO<sub>2</sub> and SO<sub>2</sub> to the air

Besides power generation, emerging technologies can help in many different ways such as green designs, establishment of environmentally friendly manufacturing processes, miniaturization, development of advanced production techniques, and invention of smart materials.

Emerging technologies can help design products, homes and workplaces in a green manner. Examples are energy saving lights, intelligent energy utilization control, recyclable materials and renewable energy from natural resources.

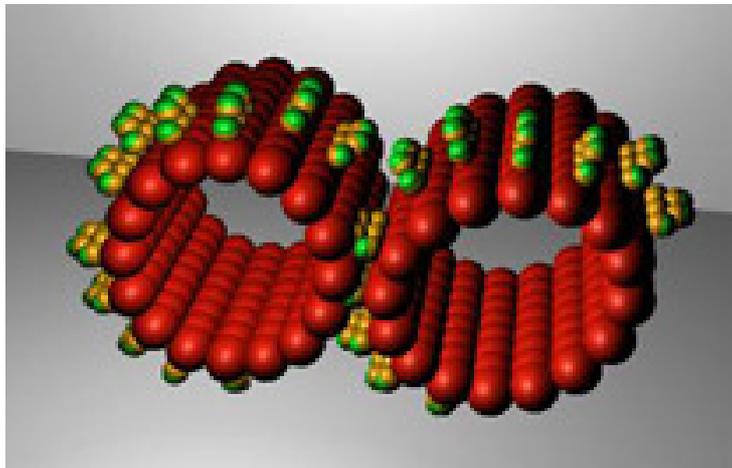
### 2.3.2 New technologies to improve quality of life

Nanotechnology is a star over the last decade. The changes brought by it to the modern life range from manufacturing to tools, materials, foods and cosmetics that enable people to manage large projects and to manufacture products for living and pleasures.

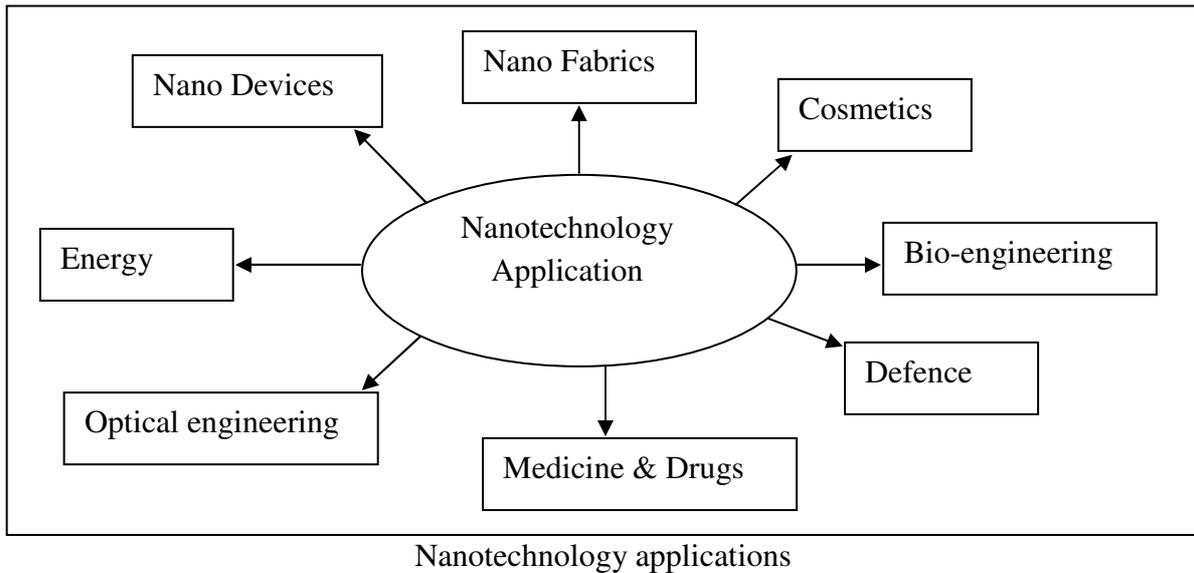
Nanotechnology is considered applied science and technology, covering various topics, such as colloidal science, device physics, and supramolecular chemistry. In short, it deals with matter of one micrometre in size or even smaller. A micrometre is between 1-100 nanometres.

What new science and technology might result from such diverse researches is still an unknown to people. While nanotechnology is used as a marketing term, if not a gimmick, by some people, many practical researches are being done. For example, building micro-machines, creating new skins, delivering medicine through nano-tubes, uncovering sources of pollution by nano-scaled tracers, detecting virus or bacteria by nano-scaled bio-sensors, and helping digestion or nutrient absorption.

With nanotechnology, it is believed that human beings can achieve goals on environmental protection, medical implantation, manufacturing processes and many any others that they and their ancestors could never reach before.



Nanotechnology – the Nano-gear

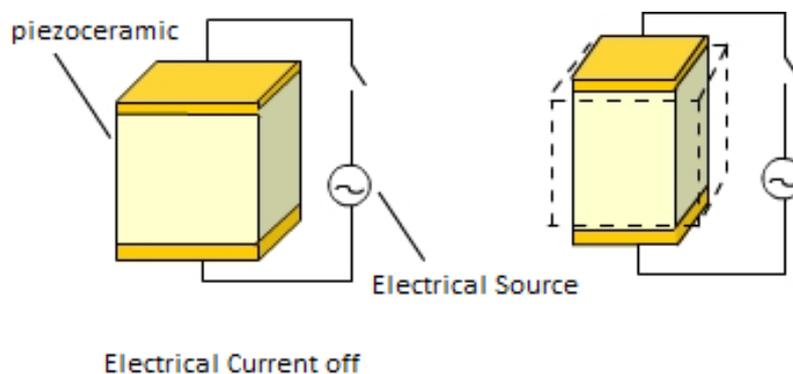


Scientists and engineers make use the special properties of new materials to many applications in recent years. For example, some materials can change their shape or sizes when heated, or change from liquid to solid when placed near a magnet. Such materials are called smart materials.

The changeability of smart materials' properties allows great development in the field of material science.

The family members of smart materials include piezoelectric materials, magneto-rheostatic materials, electro-rheostatic materials and shape memory alloys. Some of them have already been, and many others are going to be, incorporated in daily life, such as coffee pots, cars and eyeglasses.

Piezoelectric materials have two unique but interrelated properties. Firstly, a piezoelectric material will release a tiny but still measurable electrical discharge when deformed. Secondly, a piezoelectric material's volume will enlarge up to 4% when an electrical current passes through it.



Electro-rheostatic (ER) materials will turn from a thick fluid (high viscosity; similar to motor oil) into an almost-solid substance within as soon (in milliseconds) as exposed to an electric field. The fluid state will be resumed almost as soon as the field is removed. ER fluids may simply be made of milk chocolate or cornstarch plus oil. They can be used in clutches and valves, and engine mounts for reduction of noise and vibration in vehicles.

Magneto-rheostatic (MR) materials change and reverse likewise when exposed to a magnetic field. MR fluid could be made of small iron particles suspended in oil. They can be used for damping the vibrations of exercise equipment, prosthetic limbs, vehicle shocks, washing machines, etc.

A shape memory alloy (SMA) changes its shape when heated to a designated temperature. SMA can be used in medical / surgical parts, devices in control systems, etc. For example, an SMA pin which is out of shape can resume to its original shape when immersed in a cup of hot water. Nickel titanium (NiTi) is an SMA.

## S T O P   A N D   T H I N K

New technologies give human beings double-edged quality of life: more comfortable, convenient, etc, but worse living environment if not being deployed properly.

Describe what designers and engineers should consider when building a mega dam for hydro power generation.



## CHAPTER 3 – ENTREPRENEURSHIP AND ENTERPRISE

This chapter covers topics on:

- (a) Competitive edges of Hong Kong's manufacturing industry
- (b) Procedures for a design to meet market aspirations
- (c) Design strategies

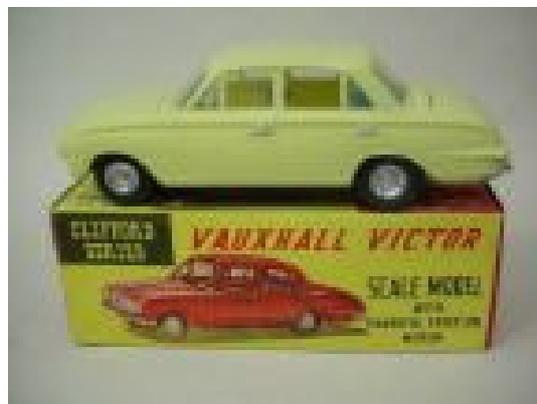
These topics include learning materials and activities that facilitate the students to:

- (i) Understand Hong Kong's small and medium-sized enterprises and their competitiveness;
- (ii) Understand the essentials of corporate strategy and business strategy in design;
- (iii) Propose business and marketing plans;
- (iv) Manage product design projects; and
- (v) Demonstrate commitment to fulfilling the wants and providing value-added products.

### 3.1 COMPETITIVE EDGES OF HONG KONG'S MANUFACTURING INDUSTRY

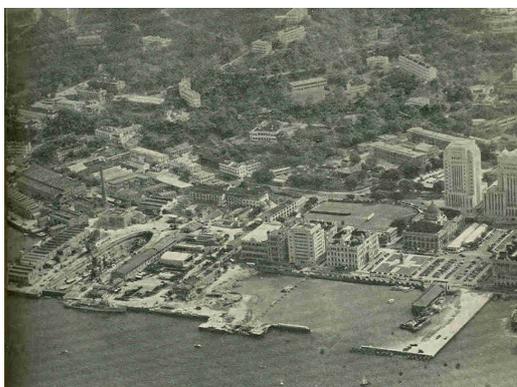
In Hong Kong, more than 90% of the businesses are small and medium-sized enterprises (SME). In other words; SME's business is Hong Kong's business. This section reviews the Hong Kong economy from the early 1950's to today, and locate Hong Kong's competitive edges that support Hong Kong and SME's continuous economic growth.

SME has been and is an important integral part of Hong Kong's economy. It has contributed very much to the territory's economy. Hong Kong's SME started with small factories of electronics and plastics. It was labour intensive, relying on large, cheap and low-skill workers to sustain.



Toy in the 60s

Between 1980's and early 1990's, Hong Kong's economy grew 10% per annum in average. The double digit growth was mainly driven by the government's land sales, efficient infrastructure planning and the establishment of the economic zones in the Mainland. Such significant achievements in turn improved the investment climate further. At the same time, the territory's investment in tertiary education and training diversified and provided the required manpower for the industry.



Reclamation of Central, the most important district facing the Victoria Harbour, in the 1950's



The Victor Harbour of today

### **3.1.1 Competitive Edges of Hong Kong**

Human resources, the judiciary system, financial infrastructure, economy policy, tax system, political environment, relationship with the Mainland are all Hong Kong's competitive edges and the foundation for the design and manufacturing industries.

Hong Kong has long been considered having no natural resources but human resources. With such resources, Hong Kong provides other parts of the world with goods and services in an efficient and effective, intelligent and visionary, adaptive, and responsive manner. An educated and learned society offers opportunities to and grows talents. At the same time, creativity is required by the design and manufacturing industries for innovative products, proper response to the changing situations, and wealth creation for society as a whole.

Hong Kong's sound legal system and financial infrastructure have promoted the territory to become a financial hub of the region, which is a driving force in funding to industry and business activities. A sound legal system protects intellectual properties and ensures fair trading, giving businessmen confidence to do business in Hong Kong. A sound financial infrastructure warrants fair business transactions and sufficient financing for large projects.

Hong Kong's free-market economic policy, simple tax system with low tax rates and political stability are all the territory's competitive edges. With minimal government and political intervention and a stable government, new investors come to Hong Kong from around the world, advantageous to the design and engineering industries.

The large size of the China market, the growing economy in China, and the tight and long-term relationship between Hong Kong and China are all great selling points of Hong Kong. The territory thus can sustain its import and export business, and at the same time have sufficient supply of land and labour for the manufacturing industry.

### **3.1.2 Influence of Entrepreneurial Activity**

Whether or not a product design is successful depends on the business strategy that a manufacturer adopts. The strategy selected determines what business activities will be implemented subsequently, such as brand building, continuous quality improvement and customer satisfaction. In general, there are three common strategies, namely design leader, quick follower and me-too.

A design-leader goes through most activities of a complete product development cycle, such as marketing, research, design, promotion, quality assurance, continuous improvement and customer satisfaction. 'Design leadership' is a hot topic in toy industry in the couple of years. (Reference: [www.woowee.com](http://www.woowee.com) – Design of Leading Robotic Toy)

In fact, many world-class toy manufacturers choose to go along the direction of OBM (Original Brand Manufacturer) or ODM (Original Design Manufacturer). An ODM manufacturer has to be involved in new technology, new materials, innovation and creativity. A design leader leads the market and is compensated with larger profit margins for the risks

that it takes on its investments on marketing, research and design.

One of the key success factors for a design leader is brand building. It may be the most difficult part for an enterprise to achieve, but it is also the cream of a business. A good brand guarantees product sales, such as Sony, Donald Duck and Nokia. It is however never easy to build and maintain a brand: the initial effort to win the market and the long-term, continuous effort to keep the market with product quality and customer satisfaction.

A quick-follower manufacturer modifies hot products and pushes the modified products to the market at the soonest time. Time-to-market is an important service that manufacturers provide to distributors. Quick follower requires no brand building but continuous improvement of quality and customer satisfaction. This strategy asks for lesser investment in research, design and marketing. The trade-off is thinner profit margins. In late 1990's, Tamagotchi swept the market. Many quick followers pushed out their designs and flooded to the market.



Quick Follower – Tamagotchi

A me-too manufacturer competes by launching similar or alternative hot products. Me-too activities include differentiation of the manufacturer's brand name from its competitors, as well as improvement of quality and customer satisfaction. The investment requirement in marketing for a me-too manufacturer is lower than a design leader. The me-too manufacturer however cannot build an innovative image since a me-too is follower in nature. Unlike quick followers, a me-too still has to do its own marketing, research, design and promotion in order to outperform similar products in the market. Similar to quicker followers, a me-too has to maintain continuous improvement and customer satisfaction for survival in a competitive market.

Educational products and stuffed toys are examples of me-too products. They are two best sellers in the world's toy market.



Educational Product for Kids



Plush Toy

### 3.1.3 Design Gaps and Options

Sometimes, products and services have been redesigned or even require replacement in order to satisfy customer needs. The gaps between customer needs and an existing product or service come from the diminishing attraction or challenge of the product or service due to time effect, new trend of tastes or lifestyle.

In order to keep the clientele, manufacturers have to revamp products and services by taking the pull-down factors and technology-push factors into consideration. The new designs have to eliminate those pull-down factors by offering products or services of better and trendy outlook, with enhanced or more functionality, made of environmentally friendly materials, etc. The new designs at the same time have to match those technology-push factors by adopting the latest technology and materials and becoming even more user-friendly. A Strength-Weakness-Opportunity-Threat (SWOT) analysis can help the above.

## H I G H L I G H T

Explain how the following factors can help Hong Kong compete with the world:

- (a) Human resources;
- (b) Judiciary system and financial infrastructure;
- (c) Economy policy, tax system and political environment; and
- (d) Relationship with the Mainland

## S T O P   A N D   T H I N K

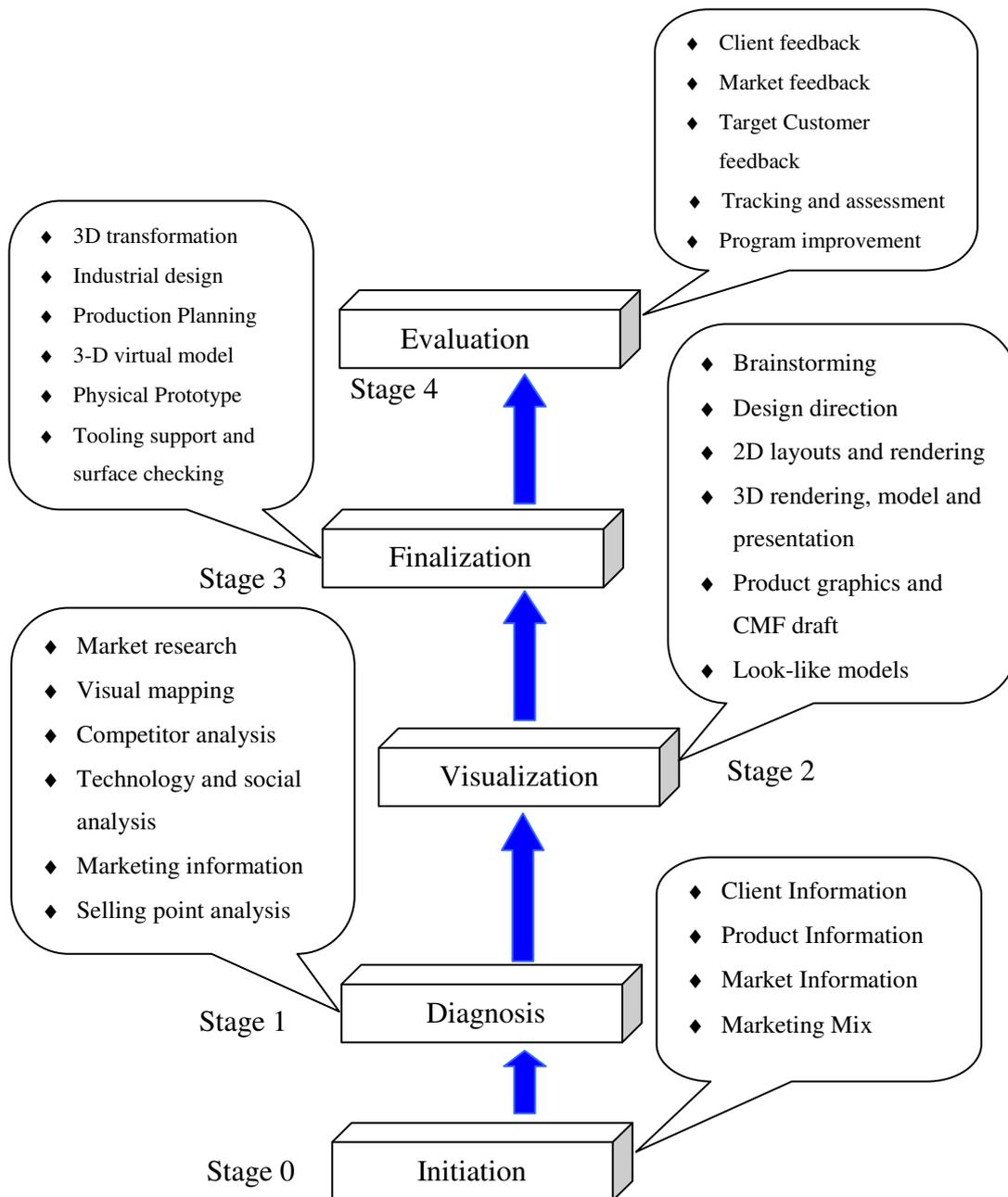
Discuss an entrepreneur activity which would help launch a watch design:

- (a) Design Leader;
- (b) Quick Follower; and
- (c) Me-too



### 3.2 DESIGN TO MEET MARKET ASPIRATIONS

Marketing information is now an important integral part of a product design and development project. In order to grasp market aspirations, such as price, value, functions, safety, a project must follow different stages:



Different stages in a product design project

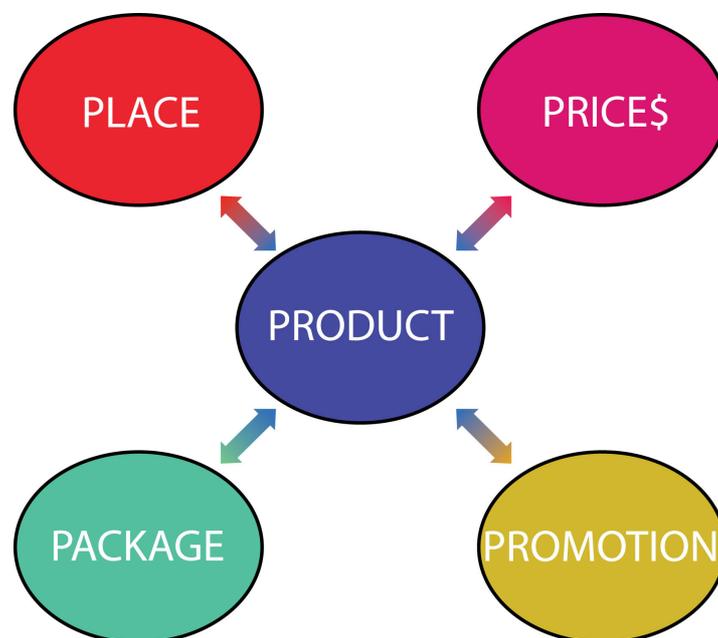
#### 3.2.1 Stage 0 - Initiation - Start with an Idea in the Air

- (a) Client Information – Designers have to collect fundamental client information and draft product plans.

- (b) Product Information – Clients have to provide basic functional and/ or aesthetic ideas on the new products.
- (c) Market Information – Clients have to provide market information, such as retail prices, target users/ age groups, packaging methods, profit margins, quotas, and shipment schedule.
- (d) Marketing Mix – Marketers have to analyse the 5 P's, i.e. Product, Place, Promotion, Price and Packaging, of the products concerned.

The deliverables of Stage 0 are:

- (a) Design Contract between Client and Design team;
- (b) Resource Capacity, Schedule and Budget



### 3.2.2 Market Positioning Analysis

Market positioning is a key step in a marketing strategy. It is to create and communicate messages to the market to clearly establish the company or brand in relation to the competitors. For example, Volvo's position is safety, while Mercedes-Benz's is good engineering.

Some products may position themselves as outstanding in two aspects or even more. The dilemma is claiming superiority in many aspects may confuse customers or even hurt the company's credibility: it is not convincing that a product can be an all-round winner.

Furthermore, the position that a company communicates to its customers may not be able to override customers' perception. Customers may form their perception through actual experiences with the company's products or by word of mouth.

A marketing strategy is only a starting point. Upon the completion of a strategy development, the company have to fix its tactics (marketing mix), which are tools for achieving the strategic goals.

- (a) **PRODUCT**
  - (i) Physical features of the product, or the characteristics of the service provided; and
  - (ii) Selling points of the product or service, such as product outlook
- (b) **PLACE**
  - (i) Where the target customers are, and how to obtain them; and
  - (ii) Distribution channels, such as retail outlets in different districts and the Internet
- (c) **PROMOTION**  
Telling the customer about the product:
  - (i) Mass Selling Advertising – cost concern;
  - (ii) Publicity – may be free of charge, by word of mouth for example, depending on the product’s popularity;
  - (iii) Sales Promotion – setting up booth at retail outlets or roadshow, enabling target customers to try the product through, for example, contests, discount coupons and free samples; and
  - (iv) Personal Selling – direct contact, person to person
- (d) **PRICE**
  - (i) Sell at a higher price for short-term, large profits?
  - (ii) Sell at a lower price to penetrate the market for long-term survival?
- (e) **PACKAGING**
  - (i) Present the product in an eye-catching way for short-term stunning effects?
  - (ii) Package the product for long-term competition?

### **3.2.3 Stage 1 - Diagnosis - Build an ovary to generate a new product**

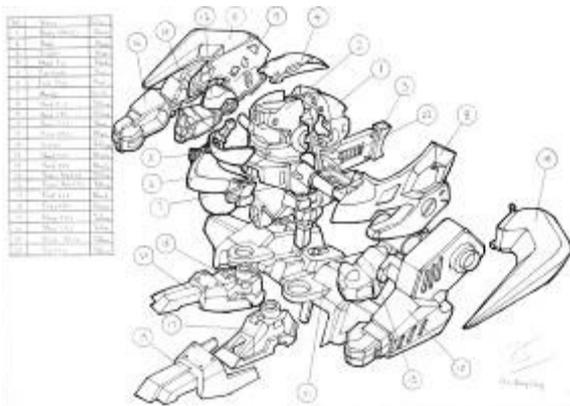
- (a) Market Research – Research on, for example, the market size, leading brands’ products and selling points/ marketing strategies, and customer feedbacks towards certain products;
- (b) Market Visual Mapping – Transform market research verbal data to visual materials, such as charts and tables, for better understanding and communication;
- (c) Major Competitor Analysis – Analyse major competitors with information collected from the market research;
- (d) Technology and Social Trend Analysis – Analyse how new technologies or materials can improve an existing product, or how new social trend offer new product opportunities:, the periodical return of Yo-Yo, Spin-top, Rubik’s Cube may stimulate

many new designs with update technologies and materials, also many new toys have been released due to new TV/cartoon/movie attractions;

- (e) Design Criteria/ Target User, Segmentation, Price and Schedule – Identify more rigid and realistic marketing information from the researches and analyses conducted;
- (f) Selling Point/ “WOW” Factors Analysis – Identify special features and their effects on target customers from competitors’ product: Will the target customers yell “WOW” when seeing or using the new design?
- (g) Strategic and Future Directions – What should be done on and for its next generation if a product is sold well? How can a long successful product line be built?
- (h) Review/ Refine with Clients – Review and, if necessary, adjust marketing plan and strategy.

### 3.2.4 Stage 2 - Visualization - What would be the product look like?

- (a) Group Brainstorming
- (b) Make a design direction based on Design Criteria and Trend Analysis
- (c) Draft preliminary 2D layouts and 2D renderings, sketch model for presentation to clients



3D Renderings, Modelling / Presents to Clients

- (d) Product Graphics / CMF (Colour, Material, Finish) Draft
- (e) Appearance Models
- (f) Review with Clients
- (g) Design Modification / 3D Modelling
- (h) 3D CAD/CAM Drawing to Mechanical Design Department

### **3.2.5 Stage 3 - Finalization - This is the PRODUCT based on previous stages**

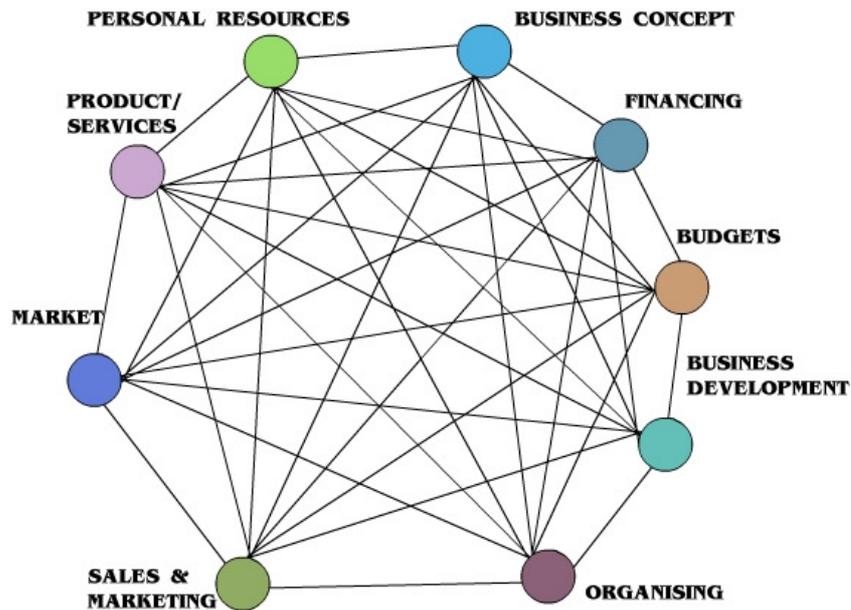
- (a) 3D Surface Engineering Transformation - Transfer aesthetic data to production compatible data, such as from 2D drawings to 3D engineering data files
- (b) Co-Design - Industrial Design plus Mechanical Engineering
- (c) Make-Up Sheets/ CMF(Colour, Material, Finish) for Production
- (d) Aesthetic Model
- (e) Working Sample/ Prototype
- (f) Tooling Support/ Surface Checking
- (g) Debugging
- (h) Packaging Design

### **3.2.6 Stage 4 - Evaluation - Is there any room to improve the product?**

- (a) Client Feedback/ Design Aspect - The feedback from clients - the Brands.
- (b) Market Feedback/ Product Aspect - During the design/ manufacturing process, the design models and prototypes are shown in fairs or other events to acquire comments and attention from buyers.
- (c) Target Customer Feedback / Product Aspect - During the design/manufacturing process, the design models and prototypes are shown to target customers with competitors' product for comparison and evaluation - Viability Test.
- (d) Tracking and Assessment – Keep monitoring the demand and supply, i.e. the ups and downs of the production volume.
- (e) Program Improvement – Formulate new marketing plans in response to market reaction and the competitors' feedback, such as price reduction, new generations, termination of production

### **3.2.7 Business Plan and Marketing Plan**

A comprehensive business plan is required in order to manage Stages 0 to 4 efficiently and effectively. The business plan shows the activities taken place at different stages, the projected income and expenditures at these stages, as well as the projected resultant surplus or deficit.



The components in a business plan

A marketing plan is usually a collective work, regardless of the size of the project or the plan. Inputs from all relevant parties, such as finance, manufacturing, personnel, supply and marketing, are crucial to a comprehensive and balanced marketing plan. For example, based on their own expertises, professionals from different areas can justify and verify what is achievable and how goals are attained. The experts can also share their insights on any potential marketing opportunities for enriching the plan.

A business plan is different from a marketing one by spelling out what the business is about, such as what to do and not to do, and what the ultimate goals are. A business plan discusses also staffing, financing, strategic alliances and so on. More importantly, it shows the readers the vision. A business plan establishes a framework for its marketing plan.

The following is an example of a business plan's projected income and expenditure section:

Description	Expenditure (HKD '000)	Income (HKD '000)
Product Design Stages		
Stage 00	300	
Stage 01	60	
Stage 02	60	
Stage 03	120	
Stage 04	50	
Costs for manufacturing and QA	100,000	
Promotion	5,000	
Commission	500	
Manpower	3,000	
Logistics	150	
Overhead (10%)	10,924	
Income from sales		200,000
Total	120,164	200,000
Net		79,836

The following is an example of a market plan's topic coverage:

Chapter	Content
1	Executive summary: giving a brief but precise description about the plan
2	Challenges: description of product, goals and sales figures
3	Situation Analysis: Company Analysis, Customer Analysis, Competitor Analysis, Collaborators, Climate, and SWOT Analysis
4	Market Segmentation: describe the market segment which the product is aimed at such as children aged 3-6 or 8-12
5	Selected Market Strategy: Product, Price, Place, Promotion and Packaging
6	Short-term and long-term projections
7	Supports from different sections of the organisation: giving details the kinds of supports, deliverables and time lines
8	Budgeting and Expenses estimations
9	Sales Forecast
10	Conclusion

## S T O P   A N D   T H I N K

Draft a simple marketing plan for either one of the following products with 5 P's to ensure that the product meets marketing aspirations.

### 1. Voice activated toy tank

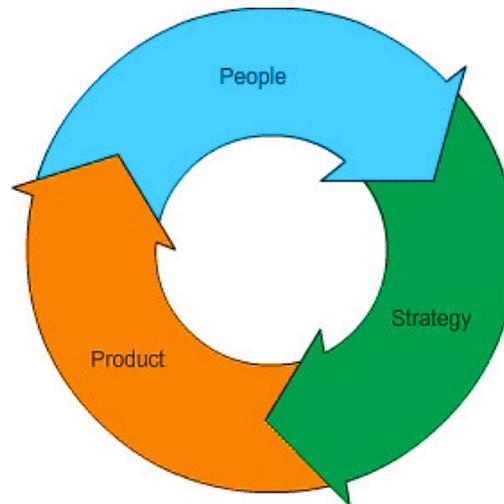


### 2. Fully articulated dolls with robotic look



### 3.3 DESIGN STRATEGIES

The competition of today's business market is much intense than ever: keep reducing the product design and development time, enhancing quality control, increasing productivity and cutting price. In order to achieve all these and many other goals together, the seamless integration of people, product and strategy is of the utmost importance.



The integration of People, Product, Strategy is an improvement initiative for industrial processes. It involves cross-functional teams, concurrent engineering, design for manufacturing, and design with environmental concerns, etc.

Initially, Apple Inc thought of producing a modern communication device in the 21st century. The company has adopted these design concepts in the production and sales of the iPhone. People of users, designers, engineers, manufacturers, marketing, frontline sales force, etc worked as a team down the road from product design to the sales.

iPhone was launched to the markets all around the world on the same day, creating a worldwide talking point. The product satisfies customer needs with contemporary technologies, state-of-the-art manufacturing techniques and multiple functions and features.

#### 3.3.1 Fulfilling Customer Wants

It is important for a profit-making company to identify customer needs correctly. In general, customers tend to purchase products at the lowest price. Therefore, many manufacturers focus on cost reduction in order to keep selling prices as low as possible. Facing the price competition from emerging countries which have even lower production and labour costs, enterprises have to explore their blue oceans: creating new markets with new products, new ideas and technologies to satisfy customers' changing wants.

Customers are to allocate their resources, such as money and time, for goods and services that they enjoy. In short, they want value for money.

In general, customers consider price the most important factor for commodity goods, such as candle for lighting, and select products as cheap as possible if everything is equal. Therefore, if a product can differentiate itself from others, such as having features of colour, texture and perfume, that product is no longer a commodity product but a 'designer product'. A designer product means that it can be sold at a higher price for the value it has been added.

Value can also be added through using environmental friendly materials and adopting environmental friendly manufacturing processes. Incorporating socially concerned value into a product permits a higher price and thicker profit margin.

Of course, the value added to a product should be in line with customers' lifestyle and culture. Therefore, a marketing team is set up, officially or unofficially, to understand the latest trend and customer wants so as to develop products accordingly.

Creating a brand and thus may or may not be more profitable than being a trend follower because design-oriented companies have to invest heavily in research and development. Firstly, a marketing team is responsible for understanding customer needs, such as user emotions, ergonomics and culture. Secondly, with the research results, the design team has to brainstorm for possible products. Thirdly, the company has to evaluate the candidate products' effects on the target customers for deciding which product(s) should be produced. Target customers may be invited to join at any stage for giving initial opinions, testing the product(s), commenting on the product(s) produced, etc.

Unlike the traditional industrial products, a styling design can reflect not only a product's intrinsic function, but also its target customers' spiritual demand, such as a fashionable outlook. A good example in product styling design is the iPod; the latest model does not only maintain the inherent functions offered by the iPod, but its outlook and features have been modernized by using wider screen and speaker etc. Combining this trend with manufacturing flexibility may pose a challenge to mass customization. Mass customization refers to the production of goods and services for individual (or smaller groups of) customers in a similar efficiency level of mass production. A good example of a product styling design is iPod.

### **3.3.2 Corporate Strategies in Product Design and Manufacturing: OEM, ODM and OBM**

Many Hong Kong manufacturers adopt OEM, i.e. Original Equipment Manufacturing. The manufacturers receive orders with designs and specifications from originating companies (or brand companies), and produce accordingly. The products produced are sold under the brand companies' names or brands. It was especially popular before 1980's when Hong Kong's production costs were still low. The brand companies were mainly foreign companies. For

example, many Mickey Mouse products are manufactured in this way.

As Hong Kong companies' design level advances, some local companies adopt ODM, i.e. Original Design Manufacturing now. An ODM company, in addition to manufacturing, designs products for a brand company to sell under the latter's brand.

An ODM company may design the entire or part of a product, or complete the design of a product with a rough description of the product from a brand company. Instead of being approached for ODM, some ODM companies may even proactively design and sell their own products to brand companies. The design work of many OEM companies are increasing, reflecting their transformation from OEM to ODM.

A company with a strong design team may choose to design, manufacture and sell under its own brand name(s). Such approach is called OBM, or Original Brand Manufacturing. OBM companies may be rewarded with higher returns, however subject to the heavy investment concern as mentioned previously. Nevertheless, some OEM or ODM companies may be reluctant to become OBM: Due to potential competition, an OEM or ODM company may lose its existing customers before its successful transformation to OBM.

Regardless of the mode adopted for manufacturing, one point is for sure – production in the Mainland and design, management and marketing in Hong Kong. Such a situation has been termed by the Massachusetts Institute of Technology (MIT) in 1997 as 'Made by Hong Kong'. The MIT report suggests that Hong Kong should invest more in research and development. A Lingnan University report issued in 2001 says that local enterprises of Hong Kong's toy industry consider creativity in product design as important as cost effectiveness, implying that local manufactures are, at least mentally, ready to invest for becoming designers.

Given the business environment, typical manufacturers face a decision of 'do or not do' design. If 'do', they face another decision of 'in or out': establishing in-house design teams or outsourcing design jobs. A company new to design, not familiar with its target new market, or not willing to invest in an in-house design team may choose to subcontract design jobs to or even buy designs from external designers. Those designers sell their designs are also known as 'inventors'.

### **3.3.3 Enterprising Behaviour**

Trustworthiness is another important asset of Hong Kong's manufacturers. Hong Kong's manufacturers are renowned for their punctuality on delivery of goods to, for example, the USA, Europe and Japan, no matter it is in low or peak seasons, such as Easter and Christmas. Also, the goods manufactured are of high quality, complying with agreed safety standards and specifications. One more point is that workers of Hong Kong manufacturers' factories are treated in a humane way.

Hong Kong companies are also considered more resourceful, adaptable and responsive to their customers than their overseas competitors are. Besides, Hong Kong manufacturers properly take up social responsibility, such as work ethics, labour laws and environmental protection.

## S T O P   A N D   T H I N K

- (a) Describe what corporate strategies OEM, ODM and OBM companies should adopt.
- (b) List what benefits OEM, ODM and OBM companies can enjoy.
- (c) Discuss whether or not Hong Kong's manufacturers can adopt OBM or even ODM.

## Theme-based Learning

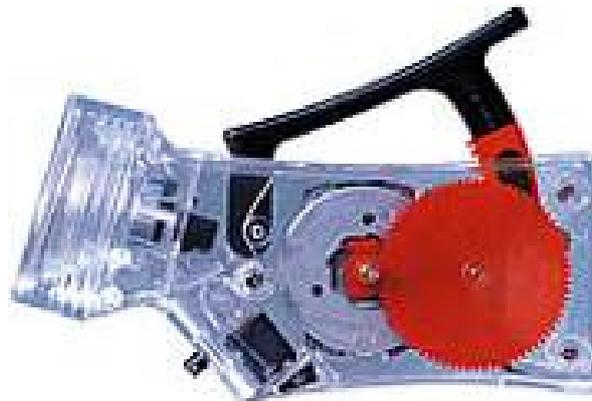
### Theme 1 - Case Study of the Motion-Powered Light Torch

This theme-based learning task enables you to

- (a) Understand the roles of designers and engineers;
- (b) Understand the value of intellectual property;
- (c) Understand how to evaluate a quality product;
- (d) Be conscious of environmental protection; and
- (e) Understand the value of applying appropriate technology to manufactured products.

#### A. Background

Motion-powered torch, as shown below, converts mechanical energy (human action) instead of chemical energy (batteries, for example) into light. A user can simply squeeze the torch handle for light without the need for batteries. The power generation process starts with the user's kinetic motion. The motion and the magnet inside the torch react to generate an electric current for the light. It is an application of the theory developed by Michael Faraday after his discovery in 1831.



Motion powered torch

Motion-powered torch is more common in bicycles. A torch is connected with one of the wheels, whose rotation reacts with the torch's magnet to generate an electric current and light.

A drawback of motion-powered torches is their limited capacity and instability due to manpower energy.



### **B. Motion-powered Torches Deficiencies**

- (a) State two potential deficiencies of a motion-powered torch compared with a battery-powered one.
- (b) Suggest a solution to each deficiency mentioned in Part (a).

### **C. Follow-up Activities**

- (a) Generate a high-level design idea about an innovative motion-powered torch;
- (b) Discuss how a design can be protected against unlawful duplication.
- (c) Discuss whether or not, and how if so, the design is environmental friendly.
- (d) Discuss whether or not, and how if so, the design makes use of appropriate technology.
- (e) Discuss the value of the design to, for example, society, the industry, the public and yourself.

## Theme 2 - Case Study of the Evolution of Wire Rotary Dial Telephone to Wireless Mobile Phone

This theme-based learning task enables you to understand

- (a) Evolution of craft and design of telephones,
- (b) Design culture, and
- (c) New technology for telephones.

### A. Background

Telephones are a necessity for many people. The modern telephones have evolved from their past through stage after stage of renovation and revolution over a century. A telephone processes signals and voice along the same cable.

A fundamental telephone consists of a bell for notifying recipients of incoming calls and a dial for callers to input numbers for making outgoing calls. The workflow is as follows:

- (a) The caller picks up the handset of a telephone;
- (b) The switch hook is released by the pick-up;
- (c) The wires close and form a circuit (Circuit 1);
- (d) An electric current flows through the circuit;
- (e) The telephone exchange detects the DC;
- (f) The telephone exchange sends a dial tone to the calling telephone to indicate the readiness of making calls;
- (g) The caller inputs the numbers required through the dial;
- (h) The tone generator behind the dial converts the numbers into Dual-tone multi-frequency (DTMF) tones;
- (i) The telephone exchange connects the caller's line to the recipient's line that the telephone represents;
- (j) The telephone exchange sends a signal to the telephone at the recipient side;
- (k) If the receiving telephone is on hook, the signal-induced current passes through the receiving telephone's alerting/ notifying devices, such as a bell, which are connected to a different circuit (Circuit 2), notifying the recipient of the call;
- (l) When a recipient picks up the handset, the switch hook disconnects the alerting/ notifying devices (Circuit 2) and forms another circuit (Circuit 3, same as Circuit 1 but at the recipient side); and
- (m) The line is thus established and the caller can talk to the person answering the call.

The voice parts of a telephone inside the handset consist of

- (i) A transmitter, i.e. microphone; and
- (ii) A receiver.

The transmitter receives the voice from a user, and converts the acoustic pressure waves produced by the voice into electric currents of different strengths. The ups and downs of these currents are transmitted along the telephone line to the receiving end. The receiver feeds the currents into its coil, which acts as a loudspeaker to reproduce the acoustic pressure waves of the transmitter to the recipient's ear(s).

When a party of either side hangs up the call, the DC ceases to flow, signalling the telephone exchange to disconnect the telephone call.

## B. Wired Telephones to Wireless Mobile Phones

(a) Different generations of wired telephones



(b) Different generations of wireless mobile phones



## C. Follow-up Activities

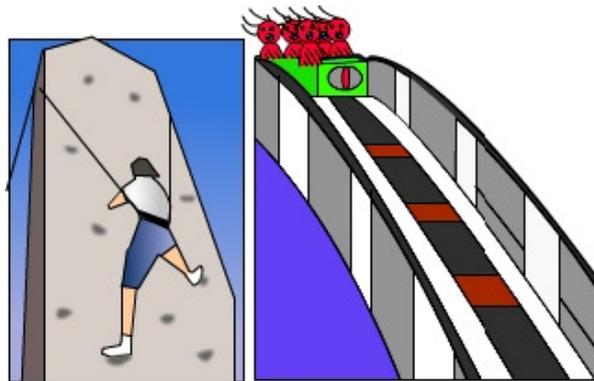
- Describe the technologies used in different generations of telephones.
- Describe how the designs of telephones have evolved.

### Theme 3 - The Design of an Interactive Game for a Theme Park in Hong Kong

This theme-based learning task enables you to understand different stages of a design process, design strategies, and also the efforts to inspire visitors.

#### A. Background

Many theme parks, such as Ocean Park and Disneyland in Hong Kong, are installed with interactive games or plays as to attract visitors. These games may be designed for single players or a group of players.



Wall Climbing

Roller Coaster

To evaluate the success of a game or play, whether or not the game or play can provide the players with fun, excitement and challenge should be looked into. To evaluate the success of the design, whether or not the game or play is attractive, fitting the environment, innovative, meeting market aspiration, and safe should be focused on.

Similar to other products, the designer of a game or play can adopt a design strategy of design leader, quick follower or me-too. A design-leader design should be innovative enough, bringing high added-value features to visitors. A quick-follower design may be modified from other latest, popular designs in the market. A me-too design is more ordinary or traditional.

One of the competitive edges in Hong Kong is its close relationship with the Mainland. A design can be even more successful if it can take advantage of this factor, such as low costs in land and manpower, large population and thus market, and same source of culture.

#### B. Follow-up Activities

- Describe what factors should be considered for the design of an interactive game for a theme park.
- Describe what factors can make a design competitive and be able to inspire and attract visitors of different age groups.
- Describe the three common design strategies. Compare their pros and cons.

## Assessment Tasks

### Assessment Task 1 - Case Studies

#### Case 1: Design a Lamp Shield

##### Strategy and Activity

Imagination can revive any residues, making an interesting and useful new life for them.

- (a) Collect a considerable amount of identical residues, such as plastic bottles and aluminium cans; and
- (b) Design and construct a lamp shield with the design principle of 'repetition'.



A design of 'Milk bottle' hanging light

#### Case 2: Design for a Theme Museum

##### Strategy and Activity

- (a) Visit either Hong Kong Science Museum or Hong Kong Space Museum;
- (b) Identify any design opportunities, such as signage and display system and souvenirs that can represent the museum; and

- (c) Suggest how to improve the museum's interactive facilities.

### Case 3: Design of a Toy iPod

#### Strategy and Activity

- (a) Generate a high-level design concept about a toy iPod for the age group of 6 to 10
- (b) Discuss and justify how the new product concept will be implemented
- (c) Compare and contrast the customer requirements of this toy product and the existing one in the market
- (d) A commercial iPod aims at youngster or adult market and, therefore, the outlook and functions have been designed to match the style and be operated by this group of users. For the toy iPod, the outlook should be designed to match the style of the children group and designers should pay more attention to safety, robustness, and ease of operation etc.



A commercial iPod



A toy iPod

## Assessment Task 2 - Practical Task

### Topic: Design and Drawing Skills

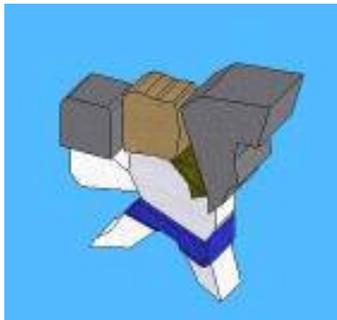
#### 1: Creation of Design and Sketch (60 minutes)

- (a) Create a design which conveys the message of 'Win and Pride'; and
- (b) Use free-hand sketch or SolidWorks to produce the design.

#### 2: Presentation of Design and Sketch (30 minutes)

- (a) Describe the idea and how it is reflected in the design;
- (b) Elaborate the design with perspectives of market aspiration and design strategy; and
- (c) Suggest how the product can be fabricated with new and appropriate technology in an environmental friendly manner.

The following two designs are for reference.



## Assessment Task 3 - Quizzes

### Quiz 1 – The Changing Roles of the Designers and Engineers in Society

#### Multiple Choice Questions

1. Which of the following is not an impact on the design of a product?
  - A. The design is ready for further improvement.
  - B. The design considers the health, safety and environmental issues.
  - C. The design is user-centred.
  - D. The design follows professional ethics.
  
2. What is the philosophy of a user-centred design?
  - A. It incurs the lowest cost to the users.
  - B. It is a promotion and publicity for the product.
  - C. The needs, wants and limitations of the ultimate users have been taken care of at each stage of the design process.
  - D. After-sale services are provided to end users.
  
3. Which of the following is not a health and safety concern of the product?
  - A. Whether or not the materials used are hazardous to end users
  - B. Whether or not the product creates ill effects to ultimate users
  - C. Whether or not the product can be stored, carried, disposed of and recycled
  - D. Whether or not the technology employed is not contemporary
  
4. Upholding professional ethics is to:
  - A. Use resources more effectively and efficiently.
  - B. Force the related practitioners to follow the code of professional responsibilities.
  - C. Minimize conflicts among professionals.
  - D. Build a happy working environment.
  
5. Which of the following is the most serious situation that Hong Kong is facing regarding solid waste disposal?
  - A. There is a lack of companies in the disposal business.
  - B. Hong Kong people tend to buy products of low quality.
  - C. Hong Kong use outdated technology to handle solid wastes.
  - D. Landfill space in Hong Kong will soon be full.

6. Which of the following is the most serious consequence that a badly designed product can result in?
  - A. Casualties
  - B. Higher product price and thus inflation
  - C. Prohibition on sale in large stores
  - D. Incorrect use of materials
  
7. Which of the following is a result of bad disposal behaviour?
  - A. Higher product price and thus inflation
  - B. Excessive use of materials
  - C. Environmental problems and conservation of resources
  - D. Lower quality products
  
8. Which of the following is a solution to bad disposal behaviour?
  - A. Use of more expensive products
  - B. Use of recyclable materials
  - C. Proper collection of wastes
  - D. Development of more wastes dumping areas
  
9. The price of disposing wastes is
  - A. Low.
  - B. High
  - C. Minimal.
  - D. Unconcerned.
  
10. Professional engineers and designers should
  - A. Be responsible for developing and manufacturing successful products.
  - B. Be responsible for disposing wastes.
  - C. Observe social responsibility in developing and manufacturing products.
  - D. Get higher pay for their efforts.

### Long Questions

1. Discuss how designers and engineers can facilitate preservation of the environment.
2. Discuss and explain what factors should be considered before a consumer procures a product.

3. Describe what attributes a successful product should possess.
4. Describe what attributes of Transformers make the product so attractive to buyers.
5. Describe some generally accepted professional ethics.

## Quiz 2 – Intellectual Property

### Multiple Choice Questions

1. In Hong Kong, the Intellectual Property Department is responsible for
  - i. Assisting the government in formulating policies and legislation on intellectual property;
  - ii. Carrying out public education programs;
  - iii. Fighting any criminal acts of infringement of intellectual property rights
  - A. i only
  - B. i and ii
  - C. ii and iii
  - D. i, ii and iii
  
2. Which of the following item is not protected under the copyright law?
  - A. Computer software
  - B. Choreographic work
  - C. Photographs
  - D. Architectural works
  
3. Which the following statement is true?
  - A. An article is not copyrighted if it doesn't have a copyright notice.
  - B. Any articles or diagrams on the Internet can be copied and distributed freely since they have been shown in a public area already.
  - C. Copyright of a work comes into existence as soon as the work is created.
  - D. Copying a work for distribution is legally acceptable as long as the copying is partial but not full.
  
4. Which of the following is/ are included in examining a trade mark registration?
  - i. Deficiency checking;
  - ii. Acceptance of application and publication for opposition;
  - iii. Compliance with the requirements of the Trade Mark Ordinance and Trade Mark Rules; and
  - iv. Registration and issue of certificate of registration
  - A. i and ii
  - B. ii and iii
  - C. I, ii and iii
  - D. All of above

5. A design can be registered only if it is
  - i. New;
  - ii. Having individual character; and
  - iii. Disclosed to the public
  - A. i and ii
  - B. i and iii
  - C. ii and iii
  - D. All of above
  
6. Which of the following does intellectual property refer to?
  - A. The owner of a physical property
  - B. The developer of a product
  - C. The intangible property right of a commodity
  - D. The end users' properties.
  
7. Under which of the following can copyright of a work be granted to a person?
  - A. Upon payment of the registration fee
  - B. Upon registration
  - C. Before the work is put to the market
  - D. When the work is created
  
8. Trademark is used to
  - A. Raise the selling price of a product.
  - B. Identify the trader of a product.
  - C. Guarantee a product is value for money.
  - D. Warrant a product's repair and maintenance.
  
9. Registered design is
  - A. Protected upon registration.
  - B. A profit-guaranteed product.
  - C. A trademark of a product.
  - D. A top-price product in the market.
  
10. iPhone is
  - A. Protected by Apple Inc.
  - B. A top-price product in the market.
  - C. A product allowing selective users to have the right to certain functions.
  - D. A trademark of Apple Inc.

Long Questions

1. Explain the importance of protecting intellectual property to society.
2. Describe the differences between copyright and patents.
3. Explain why patent and trademark can be applied to iPhone.
4. Explain why the intellectual property of a movie is a copyright, and state the validity of the right.
5. Explain why intellectual property should be respected.

## Quiz 3 – Product Evaluation

### Multiple Choice Questions

1. In which of the following stage(s) does a company perform product evaluation?
  - i. Research stage;
  - ii. Design stage; and
  - iii. Development stage

A. i only  
B. i and ii  
C. ii and iii  
D. All of above
  
2. Which of the following is not commonly used for the presentation of product evaluation?

A. Flowcharting  
B. Animation  
C. Virtual prototyping  
D. Simulating
  
3. Which of the following parties often participate in the evaluation of a product proposal?
  - i. Target customers of the product;
  - ii. Manufacturing experts;
  - iii. Outsiders of any kind, such as environmental experts and members of district councils; and
  - iv. Schools or associations of professional designers

A. i only  
B. i and ii  
C. i ,ii and iii  
D. All of above
  
4. Which of the following statements is false?

A. An evaluation process can minimize large changes at the end of the development cycle.  
B. An evaluation process can minimize the chance of facing unexpected financial stress at the end of the development cycle.  
C. The cost of making changes decrease as the development cycle approaches its end.  
D. Proper evaluation should be performed before decisions are made.

5. Which of the following decision making tools is the most widely used in product development?
- A. Product evaluation
  - B. Evaluation Matrix
  - C. Product Matrix
  - D. Decision Matrix
6. Which of the following best describe 'Product Evaluation'?
- A. It enables the designers and manufacturing experts to reduce the manufacturing costs.
  - B. It adds attractive features to the product.
  - C. It enables engineers to locate where the product defects are.
  - D. It enables the product development team to determine how good the product is.
7. Which of the following best describe 'Product Presentation'?
- A. Designers to demonstrate a proposal to people.
  - B. Engineers to verify an engineering design.
  - C. Manufacturers to decide the materials to be used for production.
  - D. Marketing personnel to show the product to people.
8. Which of the following best describe 'Rapid Prototyping'?
- A. It is a 3D drawing of a product.
  - B. It refers to the transformation process of CAD data to a physical model.
  - C. It refers to the rapid process that a laser cutting machine undergoes.
  - D. It is an electrical engine.
9. Which of the following best describe an evaluation matrix?
- A. It is a test of product concepts for selection of the best design.
  - B. It is a mathematical tool for estimating manufacturing costs.
  - C. It is a work or production schedule of a product under development.
  - D. It is an evaluation process on the quality of a product.
10. Which of the following best describe 'Performance-cost Comparison'?
- A. The purpose of the comparison is to find out the performance of a costly product.
  - B. The purpose of the process is to compare the price-to-cost ratios of two similar products.
  - C. It is a process comparing the performance of two similar products.
  - D. It is a process comparing the prices of two similar products.

Long Questions

1. Explain the importance of product evaluation in a product development cycle.
2. Describe three common presentation methods of presentation. Compare their pros and cons.
3. List the parties who should participate in product evaluation.
4. Describe a product evaluation methodology.
5. List two ethical issues that a product designer should take into consideration.

## Quiz 4 – Environmental Responsibility

### Multiple Choice Questions

1. Which of the following considerations cannot avoid or minimize a design's impact on the environment?
  - A. Do not use hazardous substances
  - B. Minimize the production cost
  - C. Minimize the use of materials
  - D. Minimize the use of energy
  
2. Which of the following is/ are impact(s) on the environment?
  - i. Create or intensifying the greenhouse effect;
  - ii. Polluting the environment;
  - iii. Reducing the atmospheric ozone layer; and
  - iv. Unbalancing the economies
  - A. i and ii
  - B. ii and iii
  - C. i, ii and iii
  - D. All of above
  
3. Which of the following is the cause of the atmospheric ozone layer's depletion?
  - A. Chlorofluorocarbons (CFC's)
  - B. Carbon Dioxide (CO<sub>2</sub>)
  - C. Sulphur Dioxide (SO<sub>2</sub>)
  - D. Nitric Dioxide (NO<sub>2</sub>)
  
4. Which of the following power plant is the most environmental friendly?
  - A. Nuclear power plant
  - B. Hydro power plant
  - C. Coal-fired power plant
  - D. Natural gas power plant
  
5. Which of the following gases is not released by a traditional fossil fuel fire power plant?
  - A. Chlorofluorocarbons (CFC's)
  - B. Carbon Dioxide (CO<sub>2</sub>)
  - C. Sulphur Dioxide (SO<sub>2</sub>)
  - D. Nitric Dioxide (NO<sub>2</sub>)

6. Which of the following is fundamental about environmental protection in product development?
  - A. Educating users how to use the product properly
  - B. Investing more in the product
  - C. Designing the product properly and using appropriate technology
  - D. Hiring environmental protection experts
  
7. Which of the following best describe 'Sustainable Development'?
  - A. Business can carry on and be successful.
  - B. It is a job of professional engineers.
  - C. It is a matter of environmental protection.
  - D. It is a balance between the needs of human beings and the protection of environment.
  
8. Which of the following best describe the greenhouse effect?
  - A. The effect resulting from growing vegetables in a house
  - B. The all-weather environment that a house is maintained with
  - C. The effect resulting from the atmosphere's absorption of heat and re-radiation part of the heat back to the earth
  - D. The effect that a house is painted in green
  
9. Which of the following is the purpose of having environmental legislation?
  - A. To fine people who do not comply with the legislation
  - B. To eliminate the greenhouse effect
  - C. To enforce investment on environmental protection
  - D. To draw professional engineers and designers' attention to the importance of environmental protection
  
10. Which of the following best describe 'Clean Technology'?
  - A. Using fossil fuels that do not contaminate the environment
  - B. Employing low-cost technology
  - C. Adopting technology that use energy efficiently
  - D. Developing technology that enables higher productivity

### Long Questions

1. Explain what the greenhouse effect is, and suggest how to minimize its impacts.
2. Explain what eco-design is, and suggest how to achieve it.

3. Describe how people can improve the air pollution that results from traditional power generation by fossil fuels.
4. Suggest two examples of green designs.
5. Explain what sustainable development refers to.

## Quiz 5 – Evolution of Craft and Design

### Multiple Choice Questions

1. Which of the following is/ are not the inventions of ancient China?
  - i. Compass;
  - ii. Paper;
  - iii. Printing technology;
  - iv. Gunpowder; and
  - v. Transistor
  - A. v
  - B. i and v
  - C. ii and iv
  - D. All of the above
  
2. The technology timeline can be a history of an inventor. Sort the following items to show the technological evolution of the telephone.
  - i. Rotary dial;
  - ii. Internet accessibility;
  - iii. Cordless handset; and
  - iv. Touch-tone keypad.
  - A. i, ii , iii and iv
  - B. i, iv, iii and ii
  - C. iv, i, iii and iv
  - D. i, iv, ii and iii
  
3. Which of the following is the correct period for the invention of transistors?
  - A. During the spread of publishing techniques.
  - B. In the electricity and modern world.
  - C. During the steam power and industrial revolution.
  - D. In the computer and information age.
  
4. Which of the following describes the period that people started using steam power for driving purposes?
  - A. Application of natural resources period
  - B. Application of natural power period
  - C. Industrial revolution period
  - D. Computer and information period

5. Which of the following best describe the evolution of material inventions and applications for the last 300 years?
  - A. Less complex
  - B. More complex
  - C. Less expensive
  - D. More expensive
  
6. Which of the following is the purpose of design activities for designers?
  - A. Working with engineers
  - B. Deciding the capital requirement
  - C. Considering various propositions and coming up with a solution
  - D. Deciding the space of the workplace
  
7. Which of the following is an important factor for product designers to consider?
  - A. Price of design and manufacturing costs
  - B. Transportation fees
  - C. Management fees
  - D. Hygiene of the workplace
  
8. Which of the following is the reason leading to the invention of steam power?
  - A. Peoples' safety awareness
  - B. Human-designed power for driving purposes
  - C. Peoples' awareness to occupational health
  - D. Peoples' better living environment
  
9. Which of the following is the Art Nouveau design style based on?
  - A. Natural environment
  - B. Artificial environment
  - C. Natural shape
  - D. Natural scenery
  
10. Which of the following best describe the Bauhaus style of design?
  - A. Aesthetic design focused
  - B. Suitability for machine and mass production focused
  - C. Product durability focused
  - D. Product size focused

Long Questions

1. Discuss the way in which the design of telephones has been changed.
2. Discuss, in terms of technology and materials, the evolution of the design for automobiles from year 1922 to recent years.
3. Describe the five important periods of technology development.
4. Describe the focus of modern design styles.
5. Describe the significant contributions of the invention of computer.

## Quiz 6 – Design and Culture

### Multiple Choice Questions

1. Which of the following explains why culture has influence on design?
  - A. Different cultures have different qualities of life.
  - B. Different cultures have different eating habits.
  - C. Different cultures have different ways of processing the information people sense in the world.
  - D. Different cultures have different drinking habits.
  
2. Which of the following factors enable designers to make their design ideas more effective in this rapidly evolving and complex global market?
  - A. Influencing the global market by the designers' own cultures
  - B. Designing for the western culture
  - C. Considering cultural relevance
  - D. Replacing old technology by new technology
  
3. To which of the following the western culture pays more attention in general?
  - A. Motion
  - B. Context and relationships in a picture
  - C. Central or dominant objects
  - D. Limited objects
  
4. Which of the following is a good starting point for applying new ideas and innovation to design work?
  - A. Getting a doctorate from a university
  - B. Getting a group of people with wide coverage of knowledge
  - C. Holding simple workshops to draw the designers' awareness to the relationship between design and different cultures
  - D. Studying the nature
  
5. Which of the following is a result of the desire for change in design?
  - A. Pushing designers to incorporate new ideas
  - B. Making designers more demanding
  - C. Leading to competition
  - D. Promoting higher selling volume

6. Which of the following should be done to customize products for different cultures?
  - A. Relying on designers of different cultures and backgrounds
  - B. Incorporating the design to be sympathy with the culture in which the device will be used
  - C. Launching a product series designed for different cultures
  - D. Changing the colour theme of the product designs for different cultures
  
7. Which of the following is a factor that affects the development of industrial design?
  - A. Engineers' preferences
  - B. Designers' tastes
  - C. Weather and climate
  - D. Social culture, economic and technologies
  
8. Which of the following best describe the American style of design?
  - A. Built-in obsolescence
  - B. Built for long lasting
  - C. Built with flashy design
  - D. Built for old fashion
  
9. Which of the following best describe the European style of design?
  - A. Built with functional, rational and pragmatic approach
  - B. Built for long lasting
  - C. Built with flashy design
  - D. Built for old fashion
  
10. Which of the following best describe the Scandinavia style of design?
  - A. Built with functional, rational and pragmatic approach
  - B. Built for long lasting
  - C. Built with flashy design
  - D. Built for human style

### Long Questions

1. Compare the cultures of the west and east on design.
2. Discuss what technologies changed our behaviour in communication.
3. Describe the factors that lead to the rapid growth of Japanese design.

4. Explain why German made products are well-known for quality.
5. Describe the different design styles existing in the USA.

## Quiz 7 – New Technology

### Multiple Choice Questions

1. Which of the following is not affected by new technology?
  - A. Home appliances
  - B. Bicycles
  - C. Energy from the sun
  - D. Cosmetics
  
2. Which of the following is not a well-known by-product of new technology?
  - A. Hill fire
  - B. Acid rain
  - C. Solid wastes
  - D. Pollutants
  
3. Which of the following is not a way that new technology can help minimize the damage of pollutants released to the environment during power generation?
  - A. Use of highly efficient and low-emission combustion engines
  - B. Use of wind power to blow away the pollutants
  - C. Use of clean fuels, such as hydro power and fuel cells
  - D. Use of efficient, green and energy saving products
  
4. Which of the following is not a smart material?
  - A. Piezoelectric materials
  - B. Magneto-rheostatic
  - C. Stainless steel
  - D. Shape memory alloys
  
5. Which of the following is not an agent causing poor air quality?
  - A. Hydro power
  - B. Power generation
  - C. Automobiles
  - D. Manufacturing processes

6. Which of the following is not considered the practice of 'green'?
  - A. Energy saving lights
  - B. Recyclable materials
  - C. Renewable energy
  - D. Fossil fuels
  
7. Which of the following does not belong to the area of application for nanotechnology?
  - A. Cosmetics
  - B. Foods
  - C. Fuels
  - D. Tools
  
8. Which of the following is a property of a piezoelectric material?
  - A. Changing shape when heated
  - B. Releasing electrical charge when deformed
  - C. Changing from liquid to solid state when magnetized
  - D. Changing from liquid to vapour when heated
  
9. Which of the following is a property of an electro-rheostatic material?
  - A. Changing shape when heated
  - B. Releasing electrical charge when deformed
  - C. Changing from liquid to solid state under the influence of an electric field
  - D. Changing from liquid to solid state under the influence of a magnetic field
  
10. Which of the following is a property of a magneto-rheostatic material?
  - A. Changing shape when heated
  - B. Releasing electrical charge when deformed
  - C. Changing from liquid to solid state under the influence of an electric field
  - D. Changing from liquid to solid state under the influence of a magnetic field

### Long Questions

1. Describe the pros and cons of new technology to the world and human beings.
2. Discuss the way new technology made changes to the audio-visual equipment at your home.
3. Describe the new technologies used in iPhone.

4. Discuss in what aspects that nanotechnology prevails.
5. Describe what emerging technologies can help protect the environment against the pollutants released in power generation.

## Quiz 8 – Competitive Edges of Hong Kong’s Manufacturing Industry

### Multiple Choice Questions

1. Which of the following did not contribute to the Hong Kong economy between the 1950’s and 1960’s?
  - A. Transference of technology from Shanghai to Hong Kong
  - B. Immigrants from the Mainland to Hong Kong
  - C. Increase in local investment
  - D. Increase in overseas investment
  
2. Which of the following did not contribute to the rapid growth of Hong Kong economy throughout the 1980’s and 1990’s?
  - A. Effective infrastructure planning
  - B. Innovation in the agricultural areas
  - C. Land sales
  - D. Setting up of economic zones in China
  
3. Which of the following is not a competitive edge of Hong Kong?
  - A. Abundance of natural energy resources
  - B. Quality human resources
  - C. Sound financial infrastructure
  - D. Close relationship with the Mainland
  
4. Which of the following is not a mandatory activity for a design leader?
  - A. Marketing
  - B. Quality assurance
  - C. Staff relationship building
  - D. Customer satisfaction
  
5. Which of the following is not an advantage for adopting a quick follower strategy?
  - A. Lower research cost
  - B. Lower marketing cost
  - C. Lower cost on improvement
  - D. Lower cost on product service

6. Which of the following is a characteristic for a me-too manufacturer?
  - A. Being able to perform
  - B. Having many inventions
  - C. Having products that outperform similar products in the market
  - D. Selling products at the lowest prices in the market
  
7. For which of the following a learning society can create the environment?
  - A. Breeding of new talents
  - B. Influx of foreign talents
  - C. Overseas investment
  - D. Further government support
  
8. With which of the following a sound legal system can provide society?
  - A. Protection of product quality
  - B. Protection of talents
  - C. Protection of corporations
  - D. Protection of intellectual properties and fair trading
  
9. Which of the following a sound financial infrastructure can ensure?
  - A. Business growth
  - B. Fair business transactions
  - C. Healthy manpower supply
  - D. Sufficient land supply
  
10. Which of the following a free-market economic policy and simple tax system with low tax rates can achieve?
  - A. Promoting export business
  - B. Encouraging people travelling abroad
  - C. Jeopardizing fair trading
  - D. Attracting investments

### Long Questions

1. Explain why human resources are an important competitive edge of the Hong Kong economy.

2. Discuss how the following competitive edges benefit Hong Kong:
  - (a) Free-market economic policy,
  - (b) Simple tax system with low tax rates,
  - (c) Sound juridical system, and
  - (d) Close relationship with the Mainland.
3. Discuss the advantages and disadvantages for adopting the design leader strategy.
4. Discuss the advantages and disadvantages for adopting the quick follower strategy.
5. Discuss the advantages and disadvantages for adopting the me-too strategy.

## Quiz 9 – Design to Meet Market Aspirations

### Multiple Choice Questions

1. Which of the following activities does not belong to the initiation stage of a product design project?
  - A. Finding the marketplace of the product
  - B. Conducting product diagnosis
  - C. Compiling technical specifications of the product
  - D. Deciding the product price
  
2. Which of the following activities does not belong to the visualization stage of a product design project?
  - A. Fixing future strategic visual positioning
  - B. Group brainstorming
  - C. Designing appearance models
  - D. Reviewing with clients
  
3. Which of the following activities does not belong to the evaluation stage of a product design project?
  - A. Receiving market feedback
  - B. Tracking and assessing results
  - C. Improving programme
  - D. Debugging
  
4. Which of the following is not part of a normal business plan?
  - A. Income
  - B. Expenditure
  - C. Staffing
  - D. Profit and loss statement
  
5. Why is a marketing plan important?
  - A. It involves top management.
  - B. It gets feedback from all parts of the company.
  - C. It involves front line staff.
  - D. It involves suppliers.

6. Which of the following is not a member of the 5 P's?
  - A. Product
  - B. Place
  - C. Price
  - D. People
  
7. Which of the following is a purpose of a marketing strategy of a product?
  - A. To establish a brand in relation to competitors
  - B. To make customers happy
  - C. To reduce the price
  - D. To offer unique products in the market
  
8. Why is a business plan important?
  - A. It shows whether or not the business is profitable.
  - B. It lists all the people involved in the business.
  - C. It reveals all activities of different stages of the business and the projected expenditures and incomes.
  - D. It shows the business transactions between companies.
  
9. Which of the following is the correct order of product design stages?
  - A. Initiation → Visualization → Diagnosis → Finalization → Evaluation
  - B. Initiation → Diagnosis → Visualization → Finalization → Evaluation
  - C. Initiation → Diagnosis → Visualization → Evaluation → Finalization
  - D. Initiation → Visualization → Evaluation → Diagnosis → Finalization
  
10. Which of the following is a purpose of Product Visualization?
  - A. It allows designers to have initial look at the product.
  - B. It allows engineers to work with designers on the final product.
  - C. It allows customers to get the prototype.
  - D. It allows finance people to estimate production costs.

### Long Questions

1. Describe what a marketer should do with the marketing mix in the initiation stage of the design product project.
  
2. Discuss the differences between a business plan and a marketing one, and how the plans help run a business or sell products.

3. Describe the tasks involved in the product diagnosis stage, and how this stage can lead to a successful launch of a product.
4. Describe the techniques used in visualization.
5. Describe the main purpose for conducting product evaluation.

## Quiz 10 – Design Strategies

### Multiple Choice Questions

- Which of the following is not a measure that companies may adopt to survive in a highly competitive market?
  - To reduce design and development time
  - To strengthen quality control
  - To wind up the business
  - To reduce production costs
- Which of the following is a possible measure that corporations may adopt to survive in a severe product competition?
  - To hire intelligent designers to manage the corporations
  - To hire professional engineers to manage the corporations
  - To involve staff of different functions in the project team for wider coverage of ideas
  - To launch series of products to the market
- Which of the following factors of integration can improve the industrial processes?
  - Capital, people and land
  - People, product and strategy
  - CEO, facilities and teamwork
  - Collaboration, intelligent and successful products
- Which of the following explains why a Designer Product can be sold at a higher price?
  - The product has added value compared with those ordinary products.
  - It is a handmade product.
  - The product is unique in the market.
  - The product is made of higher quality material.
- Which of the following explains why a brand new product is costly?
  - It involves extra costs on materials.
  - It involves extra costs on land space.
  - It involves extra costs on hiring people.
  - It involves extra costs on marketing and design.

6. Which of the following is not an option that a manufacturer may adopt to improve its industrial process for the marketability of its products?
  - A. To employ Chinese workers
  - B. To use concurrent engineering
  - C. To use cross-functional teams
  - D. To design for manufacture and environment
  
7. Which of the following is an objective of styling product design?
  - A. To reduce production costs
  - B. To reduce manufacturing time
  - C. To visually enhance the product
  - D. To make designers happy
  
8. Which of the following departments of a product design company is responsible for identifying customer wants?
  - A. Purchasing
  - B. Sales
  - C. Engineering
  - D. Marketing
  
9. Which of the following is an OEM company's business model?
  - A. The product is sold under the company's brand name.
  - B. The product is sold under the brand name of a well-known company.
  - C. The company is involved in the research and development of a product.
  - D. The company is involved in the marketing work of a product.
  
10. Which of the following is not taken place in an ODM company?
  - A. The product is sold under the brand name of a well-known company.
  - B. The product is sold under the brand name of a company which is involved in the research and development of a product.
  - C. The company is involved in the marketing work of a product.
  - D. The product is sold under the company's brand name

### Long Questions

1. Discuss the leading edges that manufacturers can rely on to engage their business in OBM or ODM.

2. Discuss how to balance the cost and value of a product, given customers' tendency to buy products of value for money.
3. Discuss what a manufacturer should do for a brand new product before the product is launched to the market.
4. Discuss iPhone's key success factors.
5. Explain the three key concerns for a product.

## Useful Websites

The list of useful reference sources are as follows:

- a Chinese Technical Press Ltd  
[www.ctphk.com/](http://www.ctphk.com/)
- b Hong Kong Education City  
[www.hkedcity.net/](http://www.hkedcity.net/)
- c Pilot Publishing Company Ltd  
[www.i-ppc.com/](http://www.i-ppc.com/)
- d Intellectual Property Department of the HKSAR  
[www.ipd.gov.hk](http://www.ipd.gov.hk)
- e The Free Encyclopaedia: Wikipedia  
[en.wikipedia.org](http://en.wikipedia.org)
- f Reference Books from Education Bureau (EDB)  
[www.edb.gov.hk/FileManager/TC/Content\\_3139/reference\\_books.pdf](http://www.edb.gov.hk/FileManager/TC/Content_3139/reference_books.pdf)

## Glossary of Terms

\* *Italicised* terms are explained elsewhere in the glossary.

Term	Description
Acid rain	The deposition of acidic components in rain, snow, dew, or dry particles. It occurs when sulphur dioxide and nitrogen oxides are emitted into the atmosphere, undergo chemical transformations, and are absorbed by water droplets in clouds. The droplets then fall to earth as rain, snow, mist, dry dust, hail, or sleet.
Assessment	The process of documenting, usually in measurable terms, knowledge, skills, attitudes and beliefs.
Biodiversity	The variation of taxonomic life forms within a given <i>ecosystem</i> , biome or for the entire Earth. Biodiversity is often used as a measure of the health of biological systems.
Biofuel	Solid, liquid, or gas fuel consisting of, or derived from <i>biomass</i> .
Biomass	Living and recently dead biological material which can be used as fuel or for industrial production.
Brainstorming	A group creativity technique designed to generate a large number of ideas for the solution to a problem.
Business plan	A formal statement of a largely enforced business goal, the reasons why they are believed attainable, and the plan for reaching those goals. It may also contain background information about the organization or team attempting to reach those goals.
CFC	Chlorofluorocarbon: a class of chemical compounds known to inflict great damage to the ozone layer.
Conservation	Reducing use of resource, through technological or social methods.
Copyright	It is the right given to the owner of an original work such as books, computer software, musical compositions, drawing, sound recordings, films, broadcasts etc. Copyright works made available on the internet are also protected. Copyright is an automatic right arising when a work is created.
Craft	A skill, especially involving practical arts. It may refer to a trade or particular art. It is used to describe the family of artistic practices within the decorative arts that traditionally are defined by their relationship to functional or utilitarian products (such as sculptural forms in the vessel tradition) or by their use of such natural media as wood, clay, glass, textiles, and metal.
Deoxyribonucleic acid (DNA)	A nucleic acid that contains the genetic instructions used in the development and functioning of all known living organisms.
Designer	The one who designs any of a variety of things. That usually implies the task of creating or of being creative in a particular area of expertise.

Term	Description
Distributor	The middleman between the <i>manufacturer</i> and retailer. After a product is manufactured it is typically shipped and usually sold to a distributor.
Economy	The system of human activities related to the production, distribution, exchange, and consumption of values like goods and services in a particular geographic region.
Ecosystem	A natural unit consisting of all plants, animals and microorganisms in an area functioning together with all the non-living physical factors of the environment.
Engineer	A person who is trained or professionally engaged in a branch of <i>engineering</i>
Engineering	The applied science of acquiring and applying knowledge to design, analysis, and/or construction of works for practical purposes
Entrepot	A trading post, where merchandise can be imported and exported without paying import duties, often at a profit.
Environment	The external conditions, resources, stimuli etc. with which an organism interacts
Ethic	A major branch of <i>philosophy</i> to the study of values and customs of a person or group. It covers the analysis and employment of concepts such as right and wrong, good and evil, and responsibility.
Evaluation	The systematic determination of merit, worth, and significance of something or someone
Flow chart	A schematic representation of an algorithm or a process
Hydropower	The force or energy of moving water.
Integrated Circuit (IC)	A miniaturized electronic circuit (consisting mainly of semiconductor devices, as well as passive components) that has been manufactured in the surface of a thin substrate of semiconductor material.
Intellectual property	It is the name commonly given to a group of separate intangible property rights including trademarks, patents, copyrights, designs, the layout design of integrated circuits, brand names or logos on cloths , articles in the newspapers, TV programmes, songs, movies, fashion designs, etc.
Interface	The communication boundary between two entities, such as a piece of software, a hardware device, or a user.
Landfill	A site for the disposal of waste materials by burial and is the oldest form of waste treatment.
Legislation	It is law which has been promulgated (or "enacted") by a legislature or other governing body.
Lifestyle	The way a person lives. This includes patterns of social relations, consumption, entertainment, and dress. It reflects an individual's attitudes, values or worldview.

Term	Description
Magnetic field	A field that permeates space, which exerts a magnetic force on moving electric charges and magnetic dipoles (such as magnets), and which can itself contain and transport momentum and energy. It is created by nearby moving electric charges, changing electric fields, and magnetic dipoles.
Maintenance	Inspect the condition of the product regularly to ensure the longevity and safety.
Manufacturer	The company that manufactures and distributes product.
Market place	The space, actual or metaphorical, in which a market operates. It is also used in a trademark law context to denote the actual consumer environment, i.e. the 'real world' in which products and services are provided and consumed.
Marketing	The process or act of making products appeal to a certain demographic, or to a consumer
Marketing plan	A written document that details the actions necessary to achieve one or more marketing objectives. It can be for a product or service, a brand, or a product line. It can cover one year (referred to as an annual marketing plan), or cover up to 5 years.
Micrometre	An SI unit of length equal to one millionth of a metre, or equivalently, one thousandth of a millimetre. It is also commonly known as a micron. It can be written in scientific notation as $1 \times 10^{-6}$ m, meaning 1 / 1,000,000 m.
Miniaturization	A continuing trend in technology toward ever-smaller scales for first mechanical, then optical and most recently electronic devices.
Nano technology	A field of applied science and technology whose unifying theme is the control of matter on the molecular level in scales smaller than 1 <i>micrometre</i> , normally 1 to 100 nanometers, and the fabrication of devices within that size range.
Nanotube	A nanometer scale wire-like structure that is most often composed of carbon.
Original Brand Manufacturer (OBM)	A company manufacturing a product which ultimately will be branded by her own for sale. Own brand development, instead of acquisition and licensing, is likely to be the option for <i>SMEs</i> , which can incubate her brands in the market.
Original Design Manufacturer (ODM)	A company manufacturing a product which ultimately will be branded by another firm for sale. Such companies allow the brand firm to produce (either as a supplement or solely) without having to engage in the organization or running of a factory.

Term	Description
Original Equipment Manufacturer (OEM)	A situation in which one company purchases a manufactured product from another company and resells the product as its own, usually as a part of a larger product it sells. OEM is the company that originally manufactured the product.
Patent	It protects the invention by giving the patent owner a legal right to prevent others from manufacturing, using, selling or importing the patented invention.
Piezoelectric	The ability of some materials (notably crystals and certain ceramics) to generate an electric potential in response to applied mechanical stress. This may take the form of a separation of electric charge across the crystal lattice.
Product	The good (economics and accounting) or service which can be bought and sold.
Promotion	It is one of the four key aspects of the marketing mix. The other three elements are product management, pricing, and distribution. Promotion involves disseminating information about a product, product line, brand, or company.
Purchase	The act of getting, buying or obtaining anything
Quality	Quality in everyday life and business, engineering and manufacturing has a pragmatic interpretation as the non-inferiority, superiority or usefulness of something.
Rapid prototype (RP)	The automatic construction of physical objects using solid freeform fabrication.
Recall	It refers to the collection of products that have been distributed to the market already.
Recyclable material	It may originate from a wide range of sources including the home and industry. They include glass, paper, aluminium, asphalt, iron, textiles and plastics. Recycling is the reprocessing of materials into new products. Recycling generally prevents the waste of potentially useful materials, reduces the consumption of raw materials and reduces energy usage, and hence greenhouse gas emissions, compared to virgin production.
Registered Design	Designs can be registered for a wide range of products including computers, telephones, textiles, jewellery and watches. Registered designs protect only the appearance of products and not the way to which the product relating to the design works, for periods of 5 to 25 years.
Regulation	A legal restriction promulgated by government administrative agencies through rulemaking supported by a threat of sanction or a fine.

Term	Description
Simulation	An imitation of some real thing, state of affairs, or process. The act of simulating something generally entails representing certain key characteristics or behaviors of a selected physical or abstract system.
Small and Medium-sized Enterprises (SME)	The companies whose headcount or turnover falls below certain limits. They are also called small and medium-sized businesses or small and medium businesses or SMBs.
Solution	A product, combination of products, services, or a mix of products and services that a vendor, service provider or value added reseller will offer to their client.
Stakeholder	A party who affects, or can be affected by, the company's actions and has a direct interest in a service being provided
Supplier	The one whose business is to supply a particular service or commodity.
Supramolecular chemistry	The area of chemistry which focuses on the noncovalent bonding interactions of molecules. It utilizes far weaker and reversible noncovalent interactions, such as hydrogen bonding, metal coordination, hydrophobic forces, van der Waals forces, pi-pi interactions, and/or electrostatic effects to assemble molecules into multimolecular complexes.
Sustainability	A characteristic of a process or state that can be maintained at a certain level indefinitely.
Trademark	It can be words (including personal names), indications, designs, letters, characters, numerals, figurative elements, colors, sounds, smells the shape of goods, packaging or any combination of these.
Ultraviolet (UV)	An electromagnetic radiation with a wavelength shorter than that of visible light, but longer than soft X-rays.
User-centered design (UCD)	A design <i>philosophy</i> and a process in which the needs, wants, and limitations of the end user of an interface or document are given extensive attention at each stage of the design process.
Violation	An act that disregards an agreement or a right.
Visualization	Any technique for creating images, diagrams, or animations to communicate a message. Visualization through visual imagery has been an effective way to communicate both abstract and concrete ideas since the dawn of man.
Wholesaler	The one sells goods or merchandise to retailers, to industrial, commercial, institutional, or other professional business users, or to other wholesalers and related subordinated services.
Wind power	The conversion of wind energy into more useful forms, such as electricity, using wind turbines.

## References

### 1. Textbooks

**Education Department** (2002). *Design & Technology [Alternative Syllabus] [S4-S5], Learning Material Trial Version.*

**John Morrison and John Twyford** (1999). *Design Capability and Awareness.* Longman.

**Royal College of Art** (1997). *Control products : design & technology 14-16.* Hodder & Stoughton

**Royal College of Art** (1998). *D&T Routes Core Book: Design & Technology 14-16, Design & Technology 14-16.* Hodder & Stoughton

林志立，陳國和 (2005)。《初中設計與科技，第一、二、三冊》。中華科技出版社。

林志立，蔡志鴻 (1998)。《高級程度工程科學，第一、二冊》。中華科技出版社。

### 2. Reference Books

**Colin Chapman & Mike Finney** (2002). *Resistant Materials.* Collins,

**Mike Finney** (2002). *Graphic Products.* Collins.

**Neville Warner** (2000). *Studies in Senior Design & Technology.* Wiley.

陳忠偉、馮景堂、曾文彬、曾照華 (1998)。《設計與科技 (第一冊)》。現代教育研究社。

金暎善 (2007)。《改變未來的 100 個新科技》。三采文化。

鄧成連 (2001)。《設計策略：產品設計之管理工具與競爭利器》。亞太。

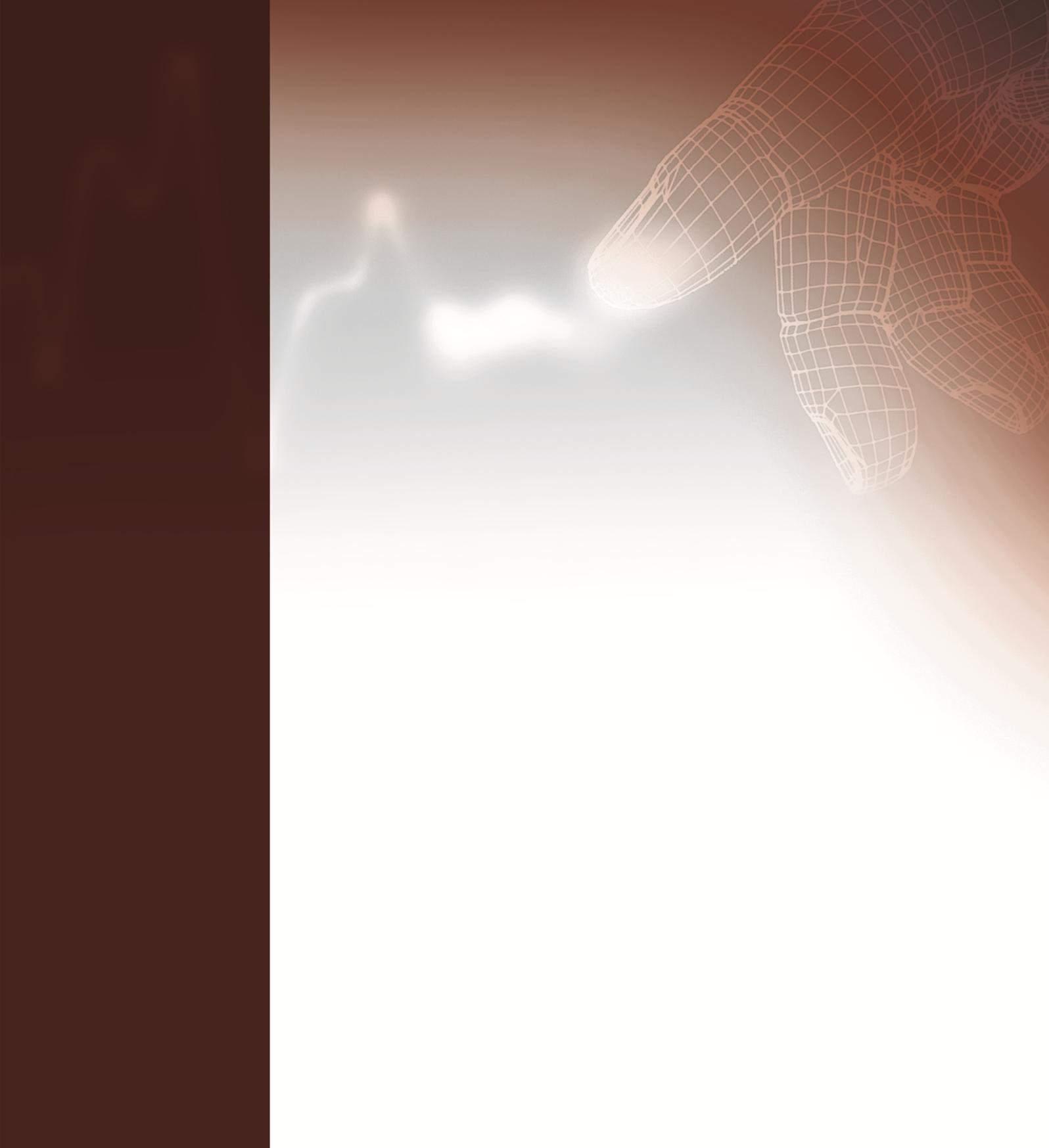
《創新與創業精神+策略九說》。臉譜文化。

## ACKNOWLEDGEMENTS

The authors wish to thank the following persons/organizations for permission to use their photographs and images:

- Under the GNU Free Documentation License:
  - (Enzo Ferrari) (Sony PlayStation 2)
  
- From the Public Domain:
  - (BMW car), (Nokia mobile phone)

Every effort has been made to trace the copyright for the photographs and images as needed. We apologize for any accidental infringement and shall be pleased to come to a suitable arrangement with the rightful owner if such accidental infringement occurs.

A wireframe hand in a reddish-brown hue is shown holding a glowing, translucent sphere. The background is a gradient from dark brown on the left to light beige on the right. The hand is positioned in the upper right corner, with the index finger pointing towards the center of the sphere.

**Technology Education Section  
Curriculum Development Institute  
Education Bureau  
The Government of the HKSAR**

**Developed by  
Institute of Professional Education  
And Knowledge (PEAK)  
Vocational Training Council**