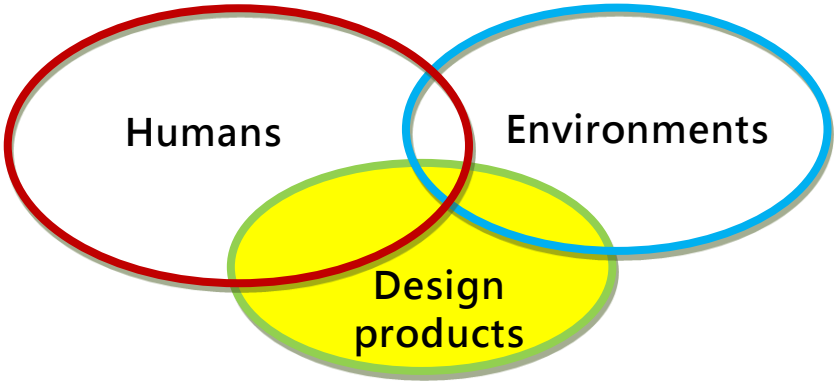
Relevant Knowledge

Design and Production of Products

Beginning from the first unit of Secondary 1, in general, we know that every design product has an interactive relationship with humans and the surrounding environments.



In this unit, we will learn more about the considerations of design. Designers and engineers are the key persons in a design process. They are responsible for making considerations and decisions during design and production processes. Furthermore, they also find ways to protect their creations. Finally, through case studies, they come to a conclusion about the choices and applications of production processes from different fields.

I Product Standards

1. What Are Product Standards?

With the development of the modern world, we are surrounded by an increasing variety of manufactured products. If every manufacturer produces its products according to its own considerations on communication and legal issues, problems on the reliability and safety of products will arise. These problems will eventually jeopardise the interests of consumers or even endanger personal safety.

It is common that we do not notice the existence of standards around us; but if there are no standards, we will soon notice and feel uneasy. For example, when there is an absence of standards, we will soon find that the products turn out to be of poor quality, do not fit, are incompatible with equipment we already have, are unreliable or dangerous. When products meet our expectations, we tend to take this for granted. We are usually unaware of the role played by standards in raising levels of quality, efficiency, safety, reliability and interchangeability, as well as in providing such benefits at a reasonable cost.

2. Benefits Brought by International Standards to Society

For businesses, the widespread adoption of International Standards means that suppliers can base the development of their products and services on specifications that have wide acceptance in their sectors. This, in turn, means that businesses using International Standards are free to compete on many more markets around the world.

For customers, the worldwide compatibility of technology, which is achieved when products and services are based on International Standards, brings them an increasingly wide choice of offers, and they also benefit from the effects of competition among suppliers.

For governments, International Standards provide the technological and scientific bases underpinning health, safety and environmental legislation.

3.International and Regional Standards

Specific product standards are applied in different regions, some of them are international and others are limited to particular countries or economic zones. The following introduces some major product standards we often encounter.

(a) ISO-International Organization for Standardization

(http://www.standardsglossary.com/isoa.htm)

ISO is a network of the national standards institutes of 154 countries, organised on the basis of one member per country, with a Central Secretariat in Geneva, Switzerland, that coordinates the system.

ISO is a non-governmental organisation: its members are not, as is the case in the United Nations system, delegations of national governments. Nevertheless, ISO occupies a special position between the public and private sectors. This is because, on the one hand, many of its member institutes are part of the governmental structure of their countries, or are mandated by their government. On the other hand, other members have their roots uniquely in the private sector, having been set up by national partnerships of industry associations.

Therefore, ISO is able to act as a bridging organisation in which a consensus can be reached on solutions that meet both the requirements of business and the broader needs of society, such as the needs of stakeholder groups like consumers and users.

ISO not only is involved in developing standards for products, but also extends its reach to other quality issues, including management systems. In addition to ISO standards for products, manufacturers and companies can also obtain ISO certificates to reflect their management quality.

International Standards are numbered with the format 'ISO nnnnn[:yyyy] Title', where 'nnnnn' is the standard number, 'yyyy' is the year published, and 'Title' is the description of the subject.

Examples:

ISO 10005:1995	Quality management – Guidelines for quality plans
ISO 8351-1:1997	Packaging – Method of specification for sacks – Part 1: Paper sacks
ISO 8351-2:1997	Packaging – Method of specification for sacks – Part 2: Sacks made from thermoplastic flexible film

(b) GB — Chinese Standards

GB is the abbreviation of Guóbiāo in the People's Republic of China (PRC), which in turn stands for Guójiā Biāozhǔn, in Chinese for national standard. GB Standards are the standards used in the PRC. Like other national standards, such as ANSI used in the United States, GB Standards cover many areas. Mandatory standards are prefixed 'GB'.

Examples:

GB4706.1-92	General safety requirements for household and similar use appliances
GB2312-80	Code of Chinese graphic character set for information interchange – Primary set

(c) CE – European Standards

'CE' is the abbreviation of the French phrase 'Conformité Européene', which literally means 'European Conformity'. The CE Marking on a product is a manufacturer's declaration that the product complies with the essential requirements of the relevant European health, safety and environmental protection legislation, in practice by many of the so-called 'Product Directives'. The CE Marking on a product indicates to governmental officials that the product may be legally placed on the market in their country.

An example of a directive:

Council Directive 92/59/EEC is a directive on general product safety. Articles in this directive state and define clearly at what standard a product should be for it to be safe.

The logo of the CE marking

(d) BS – British Standards

British Standards Institution is the UK's national standards organisation that produces standards and information products that promote and share best practice. It serves the interests of a wide range of industry sectors as well as governments, consumers, employees and society overall, to make sure that British, European and international standards are useful, relevant and authoritative. British Standards cover a wide range of areas / items, from as small as a screw to as big as a security system.

Examples of BS numbers:

BS 8888:2008 British Standard – Technical product specification

BS EN 15494:2007 British Standard – Candles. Product safety labels

Update of Standards:

To ensure the standards are in line with the changing times and technologies, the standards need to be updated from time to time. For example, BS 8888:2000 includes and replaces the drawing standard BS 308 that was widely used in Hong Kong before the handover to China.

(e) Advantages and Disadvantages of International and Regional Standards

	Regional standards	International standards
Advantages	(a) They are required in some countries, or else it is illegal to sell the products in those markets. (b) Less investment, as only a single standard is needed to be fulfilled.	Profits and number of markets can be increased as the products can be sold in more countries.
Disadvantages	Profits are narrowed as the products are restricted to a single market.	Investment costs will increase as the standards of other countries are different. To fit into more markets, the specifications have to be strengthened.

Relevant Knowlrdge

Case Study 1

Toy Design – Preventing Choking Hazards

Many accidents that lead to injuries or deaths of children result from failed toy designs. Therefore, the safety standards of toys for children are very strict. ISO has developed ISO 8124-1:2000, which is about the safety of toys. This ISO standard covers the safety requirements related to the mechanical and physical properties of toys. Among the properties, the one that influences the design process is the specification of the size of the small parts of toys, which is set to avoid choking hazards for children under 3 years of age.

Regarding choking hazards, toys designed for children under 3 years old must fulfil the following requirements:

(1) the sizes of small toys and parts of toys must be large enough so that children cannot swallow the parts (or toys);

(2) there cannot be any small parts on the toys that children can remove; and

(3) small parts of toys must be affixed securely so that children cannot loosen them or take them off easily.

International toy manufacturers have their toys tested for safety by themselves or by accredited laboratories

Relevant Knowlrdge

II Design Evaluation

We will go through various stages during the development process of a design project. Design is an activity that requires not only a creative mind, but also logical analyses for realising and developing ideas through creative processes. This is not saying that creative thinking is not needed at the later development stages. On the contrary, being creative is essential throughout the whole design process.

1. Design Stages

A design process consists of various stages. We need to set the next checkpoint at the end of each stage, when we should conduct evaluation.

Design brief

(1) Research and analysis

(2) Generation of initial ideas

(3) Evaluation of initial ideas (checkpoint – if unsatisfactory, go back to step 2)

(4) Development of design ideas

(5) Evaluation of design ideas (checkpoint – if unsatisfactory, go back to step 4; in case it is necessary, go back to step 2)

(6) Finalisation of design

(7) Visualisation of design

Functions of a checkpoint:

(1) A milestone of the end of a design stage. For certain stages, such as the idea generation stage, we may not have come to a conclusion given the time limitation.

(2) Concluding the last stage with a summary of the best solution(s). The quantity of the solution should be based on the decision made in the design brief stage.

(3) Collecting feedback on the design ideas from the others. At the end of each checkpoint, we may give clients a presentation and review the schedule of the project.

2. Selection of Design Ideas

When should we stop conceiving initial ideas? In fact, ideas never stop coming, but there must be a termination of the stage for conceiving initial ideas. That stage should end when we:

(1) have obtained a quantity of ideas that reaches the amount specified in the design brief, and there are no repeating main concepts;

(2) have reached the end of the stage according to the schedule; and

(3) believe the initial ideas are creative enough.

Relevant Knowlrdge

3. Evaluation of Initial Ideas

Design ideas are generated based mainly on the design task in the brief. We can compare the ideas and the task directly, and look for the idea that can achieve the task most effectively. The elements of a design task can be within one of the following areas.

Area	Criterion	Example
Ergonomics	The idea brings comfort.	Fitting the dimensions of human bodies and activities
User experience	The idea satisfies the users.	Fulfilling the users' aesthetic needs on visual identity
Process	The idea brings effectiveness and efficiency to the process.	(a) The time required for handling the design is shortened. (b) The design makes the handling of the process easier.
Situation	The idea brings effectiveness and efficiency to the situation.	The design takes storage and reading of the buttons on the interface into consideration.

(a) Evaluation Matrix

An evaluation matrix, or concept selection matrix, is one of the most common tools for making decisions during product development. It can also facilitate customers to examine the concepts and performance of a product, as well as choosing alternatives.

An investigation study conducted in group

(b) Methods

(1) Establish evaluation criteria

(2) Compile the evaluation matrix

(3) Rate the concepts / products

(4) Rank the concepts / products

The first step of the analysis is to put all the important attributes proposed and their weights into a table. The weights will be set when the appropriate product attributes are defined. The table also enables other people to learn about the concepts of the product.

If a drastic change has been made to the evaluation criteria, the table may need to be reconstructed.

To simplify the calculation procedure, product properties that are identical in all alternatives can be excluded from the evaluation.

It is a minimum requirement that each of the proposed and to-be-evaluated designs listed in the table contains the following two columns.

(1) Utility – which may, for example, range from 0 to 5, to evaluate the merit of each of the attributes for that proposed design.

(2) Weighted score – which is the product of Weight and Utility.

Finally, sum up all the weighted scores for each proposed design. The best alternative is the one with the highest total score.

Product attributes	**Weighting W**	**Alternative 1**		**Alternative 2**	
		Utility U	**W × U**	**Utility U**	**W × U**
Capacity	40	2	80	5	200
Ease of use	40	3	120	4	160
Design, appearance	10	5	50	2	20
Materials, recyclability	10	3	30	2	20
Total	**100**	**--**	**280**	**--**	**400**

For a simple design, the table can be simplified as follows.

Product attributes	**Alternative 1**	**Alternative 2**
Capacity	★★	★★★★★
Ease of use	★★★	★★★★
Design, appearance	★★★★★	★★
Materials, recyclability	★★★	★★
Overall performance	★★★	★★★★

Relevant Knowlrdge

The following are questions that may facilitate the design process of a product.

Product evaluation criterion	Questions
Aesthetics	• Does the product look nice? • Is it well finished? • Can it attract the target customers?
Available resources	• Are the materials, tools, machines and other necessary resources readily available?
Design for manufacturing	• Is the product easy to manufacture? • Is the manufacturing cost high?
Ergonomics	• Can the product satisfy users? • Is the product suitable for most people to use?
Ethics	• Are the materials and processes involved environmental friendly? • Will the content cause negative impact to the target audiences?
Functions	• Is the product in line with the original intent? • Does the product fit for its purpose?
Market potential	• Will there be sufficient customers buying the product? • Is it profitable for the company to produce the product?
Price / Cost	• Compared with similar products in the markets, is the cost higher or lower? • Is the price competitive in the market? • What is the unit cost of the product? • How will mass production affect the cost? • How many customers will be willing to pay for the product?
Service life of products	• What is the expected length of the service life of the product?
Quality	• Will the quality of the product be acceptable to the end users? • Can the product always perform as it should be? • Is it durable?
Safety	• Is the product safe to make, use, store and dispose of? • Can the product pass all the relevant safety tests? • Does the design contain small parts that are dangerous to children?
Time	• Is there sufficient time to develop and implement the solution?
Usability	• Who are the end users? • Is the product easy to use for the end users?

(c) Evaluation Example

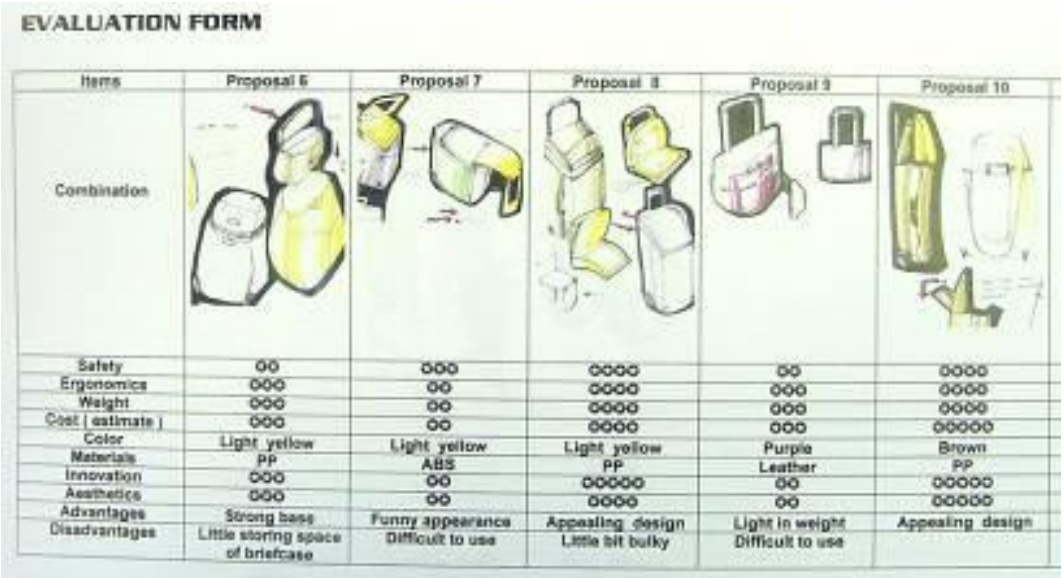
Design evaluation – Soap maker design

Throughout a design process, there must be a clear design brief and a creative idea. However, we may also reach a status when we have too many ideas such that a final decision cannot be made.

The following example is a design project of a student about a new machine specifically for making soaps at home. The research stage resulted in a list of problems which led to many design ideas. After organising all the little ideas, the student came up with a number of design proposals.

There were sketches and testing modules prepared for evaluation of the design proposals, ensuring that each of them has the potential for further development.

A comparison table was made to compare the advantages and disadvantages of the designs, in order to find out the best one.



EVALUATION FORM

Items	Proposal 6	Proposal 7	Proposal 8	Proposal 9	Proposal 10
Combination					
Safety	✪✪	✪✪✪	✪✪✪✪	✪✪	✪✪✪✪
Ergonomics	✪✪✪	✪✪	✪✪✪✪	✪✪✪	✪✪✪✪
Weight	✪✪✪	✪✪	✪✪✪✪	✪✪✪	✪✪✪✪
Cost (estimate)	✪✪✪	✪✪	✪✪✪✪	✪✪✪	✪✪✪✪✪
Color	Light yellow	Light yellow	Light yellow	Purple	Brown
Materials	PP	ABS	PP	Leather	PP
Innovation	✪✪✪	✪✪	✪✪✪✪✪	✪✪	✪✪✪✪✪
Aesthetics	✪✪✪	✪✪	✪✪✪✪	✪✪	✪✪✪✪✪
Advantages	Strong base	Funny appearance	Appealing design	Light in weight	Appealing design
Disadvantages	Little storing space of briefcase	Difficult to use	Little bit bulky	Difficult to use	

Items	Proposal 6	Proposal 7
Combination		
Safety	✪✪	✪✪✪
Ergonomics	✪✪✪	✪✪
Weight	✪✪✪	✪✪
Cost (estimate)	✪✪✪	✪✪
Color	Light yellow	Light yellow
Materials	PP	ABS
Innovation	✪✪✪	✪✪
Aesthetics	✪✪✪	✪✪
Advantages	Strong base	Funny appearance
Disadvantages	Little storing space of briefcase	Difficult to use

Student project

Mr. Ho Yip Shing, Higher Diploma in Product Design, Hong Kong Institute of Vocational Education (Shatin), 2001/2002

(i) Summarising of Initial Ideas

During the evaluation process, prediction and estimation are continuously implemented. As the ideas are still preliminary, precise information and details will not be available. We must evaluate the ideas according to their potential, instead of only their functions. When we are uncertain, we should further elaborate the ideas before making a decision.

(ii) Development of Design Ideas

As mentioned above, the initial ideas are only potential possibilities and may not be workable or practical solutions to the design problem (task). The following areas have to be refined so as to make the design more sophisticated. This process is called design development.

(1) Form

The form should fulfil ergonomic and form identity requirements, and should be tested by using detailed orthographic drawings and models of the form. The components and the way to join them should also be considered.

(2) Improving Design Ideas

This process further refines the design. To complete the design task, the process should be as effective and efficient as possible. A working model is very important in validating the above-mentioned design issues. This model can be used to test the joints and the materials. Drawings are also required for testing the visual identity and the interface.

(3) Materials and Production

At this stage, the materials used should be considered. The choice of materials will affect the functions, form and design process. The choosing of an appropriate production method then follows.

(4) Evaluation of the Developed Design

Sometimes, we need to develop several design ideas into one even better solution. During the process, new ideas can be integrated into the solution. Further evaluation has to be carried out when deciding the final design. (Refer to the SCAMPER checklist mentioned in Material 5 of S2 resources.)

(iii) Refinement of Final Design

A final design will be chosen after evaluating several developed design ideas. The design details will be further developed, including the visualisation of the final design idea and the refinement of the following.

(1) Design Details

Every detail of the design, including all the joints and fasteners (e.g. screws).

(2) Materials and Production Methods

List out all parts, and decide the material and production methods used for each one of them.

(3) Final Visualisation

Visualisation includes 2D and 3D rendering, together with scaled drawings and explanations of the usage / functions / processes of the final design. Producing a 3D model or working model to demonstrate that, the final design can perform the said functions and meet the aesthetic standards.

Relevant Knowlrdge

Case Study 2

(1) Explain the aspects involved in product evaluation.

_____

_____

_____

_____

(2) Try to devise a design matrix for the 'six-legged spider' toy model shown on the right.

'Six-legged spider' design matrix:

Item	Six-legged spider
Attractive appearance	
Safety	
Overall performance	

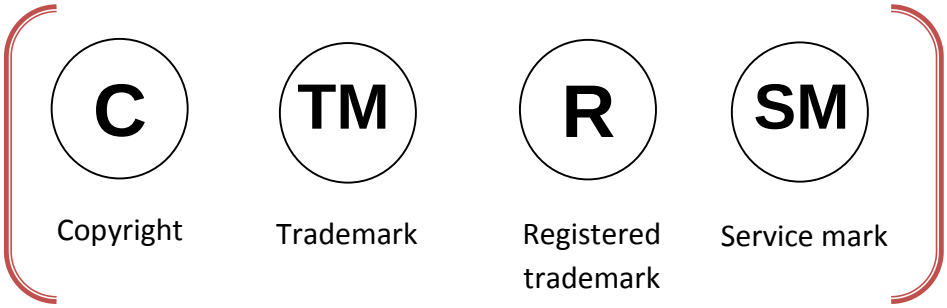
Students need to design the **rating method**.

Relevant Knowlrdge

III Intellectual Property

Intellectual property (IP) refers to intangible property rights, which are different from property rights of tangible physical objects. Types of intellectual property rights include trademarks, patents, copyright and registered designs. They are everywhere around us, examples are brand names, logos on clothes, articles on newspaper, TV programmes, pop songs, films, computer games and fashion designs.

Protecting intellectual property equates protecting creativity. However, some innovations may not be protected. For example, in order to balance the interests of all sectors of society, while a pharmaceutical invention may be protected by patent registration (whether the poor should be given no treatment because they cannot afford the patented medicine is yet another issue), the medical treatment by a specialist is not protected.



Intellectual property symbols

1. Value of Intellectual Property and Principles of Protecting Designs by Laws

To foster an environment in which creativity and hard work are encouraged and rewarded, the efforts made by artists, designers, writers, inventors, programmers and other professionals must be protected. Illegal duplications will dampen the enthusiasm of creators and make them less willing to create and work hard.

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

(a) Copyright

Copyright does not suppress an idea; it protects the expression of the idea, i.e. how the idea is expressed or presented. Expression of an idea recorded in a tangible object (or work) is protected by copyright. Examples are written records, sound recordings, pictures and photographs, original literary works, scripts, lyrics, dramas, music, drawings, sculptures, software, films, broadcasts, cable programmes and design layouts of published works. Under normal circumstances, the creator of an item is the first copyright owner.

Copyright applies automatically when an item is finished, requiring no registration. In Hong Kong, the symbol '©' is commonly used to remind people to respect copyright, but the symbol itself does not indicate that any registration has been made.

The valid period of copyright protection is 15 years or more in general. Typically, for an artistic work, the duration of copyright is the life of the author plus 50 years.

(b) Patent

Inventions can be protected by patent registration, which gives the inventors or patent owners exclusive rights. A patent holder can manufacture, use and sell products of the patented invention. The investment of the patent holder is protected against unauthorised manufacture, use, sale or import of the products of the patented invention. Patents are only granted to original, innovative and industrially applicable inventions.

An example is the Bluetooth technology, which is developed by Ericsson initially and is now owned by Bluetooth SIG, which also owns the word mark, graphic mark and combination mark of the technology. Due to its advantages such as high speed, good security and low cost, a wide range of manufacturers have integrated the technology into their wireless devices which require exchange of information in recent years. These devices include mobile phones, computers, printers and digital cameras. The manufacturers must become a member of Bluetooth SIG and pay a specific annual fee according to the size of the company to obtain permission to incorporate Bluetooth wireless technology in their products.

In most countries, patent protection lasts for up to 20 years. The protection is subject to renewal fees to keep the patent in force, which are generally payable on a yearly basis.

(c) Trademark

Trademarks are useful for distinguishing the goods or services provided by different traders. A third party is not allowed to use a registered trademark or a similar mark on its goods or services covered by the registration, unless authorisation is granted by the trademark owner. Trademark registration is valid only regionally. For example, a trademark registered in Hong Kong is protected in Hong Kong only; if protection is required in another country, registration in that country must be made.

Trademarks are graphical symbols made up of, for example, texts in different languages, logos, personal names, alphabets, 3D objects or a combination of any of the above. However, wording that describes directly or praises the goods or services are ineligible for registration.

The application process of trademark registration takes about six months. The registration is valid for 10 years, which can be extended upon expiry.

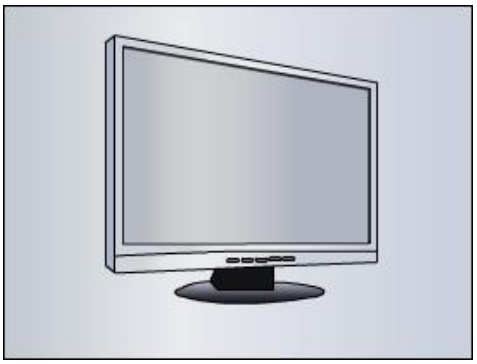
Relevant Knowlrdge

(d) Registered Design

Generally speaking, a design refers to applying a new configuration, pattern or ornament shape to an article through an industrial process, giving the article appealing features that attract people to pay attention to and review. After registration, a design will be under protection.

Only new designs are eligible for registration. If a design is disclosed to the public prior to the filing of registration application, the registration will become invalid even if the registration process has completed. Textile 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 made in other regions if protection in those regions is required. The valid period of a registration varies from 5 to 25 years, depending on the regulations set by the related country. For example, currently, a design registered in the UK is valid for 25 years, 14 years for the US and 10 years for the PRC. The protection will continue if renewal fees are paid.



Registration of the design of the appearance of a plasma TV

2. Summary

What is the importance of intellectual property in the evolution of civilisation? Intellectual property encourages innovation and creativity, promoting civilisation to evolve.

Taking mobile phones as an example, there are four main types of intellectual property they involve, including:

(1) Patent

The technical and functional aspects of the products and production processes are protected by patents, for example, the technical aspects of the parts, screen controlling and manufacturing processes.

(2) Registered design

The visual appearances and eye appeal parts of the products are all protected after design registration, such as their shape, form and appearance.

(3) Copyright

Literature, art, music, sound recordings, films, broadcasts, etc. are protected by copyright. Examples include ringtones, software, instruction manuals, and even sketches, technical drawings and models made during the development of the products.

(4) Trademark

Signs which can distinguish the goods and services of one trader from another are known as trademarks, which are protected through registration. For example, the Apple and iPhone logos are trademarks belonging to Apple Inc. Names or logos used on mobile phones, or jingles used for advertising can all be protected through trademark registration.

Relevant Knowlrdge

3. Balance of Intellectual Property

Creative Commons

Creative Commons licenses are another type of international system on intellectual property. Based on their needs, creators can choose to only 'reserve some rights', rather than 'reserve all rights' for their works.

There is a relevant organisation in Hong Kong known as Creative Commons Hong Kong, which encourages diverse creations and strengthens the development of knowledge-based industries in Hong Kong. Through education, advocacy, technical support and community involvement, it promotes the broader understanding of intellectual property laws by Hong Kong citizens and let the public know that Creative Commons licenses are an alternative legal arrangement to the current copyright system.

Creators, whether they are citizen journalists, photographers, artists, DJs, teachers or students, can use the license terms released by that organisation to indicate their own works, as well as to legitimately share the Creative Commons works by the people around the globe.

For example, when uploading information to YouTube or Flickr, one can choose to reserve a different level of intellectual property rights.

Creative Commons
Understanding this special type of copyright licenses, you can repeat the use of certain contents freely by following related regulations.

With the lack of this kind of sharing, information of well-known artists will appear like the figure on the right when we search them in websites such as Wikipedia.

Case Study 3

In recent years, the development of intelligent digital products is rapid and competition between producers of these products is intense. Brand A of the US and Brand S of South Korea have accused each other multiple times in court of copying their designs. Describe how product designs are protected in the market from being plagiarised or copied, and which aspects are outside the scope of protection.

IV Roles of Designers and Engineers at Work

Designers and engineers, together with the products they design and produce, satisfy the needs of users on the one hand and fulfil social responsibilities on the other.

1. What Is a Designer?

A designer is a person who creates designs for a variety of things. The designs range from 2D to 3D, in the medium and interactive aspects. In other words, a designer takes care of creative tasks or contributes his / her creativity in a particular area of expertise. Generally speaking, there are architectural designers, visual communication designers, product designers, interior designers and fashion designers. A designer generates new design ideas and conveys these ideas via 2D media and/ or 3D models or prototypes. A designer is usually in charge of the creation of design solutions and the planning of the steps involved in the development of a product, including not only how a product will be used, but also how it will be made.

A designer is responsible for the interface part of a design, enabling its visual, tactile and emotional contents to be delivered to the users effectively.

2. What Is an Engineer?

An engineer is someone who is trained or professionally engaged in a particular field of engineering. There are civil engineers, structural engineers, mechanical engineers, electrical engineers, electronic engineers, manufacturing engineers, industrial engineers, etc. Engineers use knowledge of technology, mathematics, science, material and process to solve practical problems.

An engineer is responsible for the technical part of a design, finding means to turn the design prototype into a product that can be used in real situations and ensuring the technical part of the design works properly after production.

3. Similarities between a Designer and an Engineer

(a) Designers and engineers are both involved in the whole design process. They work together from the beginning to the end of a project, especially when a project starts with an innovative idea and a new market. For innovative objects, they will go through the creative process together for generating new concepts.

(b) Both have clear objectives for each task. As the innovation process goes into the stage of developing the details, designers and engineers will have different tasks to complete. While most of the work is done independently, this does not imply that they work individually; instead, they cooperate to determine, for example, the size and the functions of the design.

(c) Both are involved in solving problems with a high level of creativity. Designers and engineers are both problem solvers. Even though their perspectives differ, they work together throughout the creative process to conceive the design solutions.

4. The line

A line will be drawn on every design to differentiate the two roles. The line is case- and industry-specific, which may also vanish in certain design disciplines especially when handcrafting is heavily involved, e.g. jewellery design.

(1) Above the Line

The role played by a **designer** in design is described as 'above the line', whose target is to establish a close relationship with the users via the design. A designer must consider the needs of users in the following aspects.

(a) Ergonomics (b) Practicability
(c) Market (d) Culture
(e) Emotion

(2) Below the Line

The role played by an **engineer** in design is described as 'below the line', whose target is to put the design into practice. An engineer needs to ensure that the design can provide safe and reliable service to the users in technical terms. An engineer must consider the following about the design.

(a) Usability (b) Production feasibility
(c) Industrial safety (d) Reliability
(e) Production costs

From the above, we can see that designers and engineers work independently on their designated tasks, but also complement and coordinate with each other during the process.

Relevant Knowlrdge

Case Study 4

The following is a case study about a hairdryer for illustrating the roles of designers and engineers.

(1) Above the Line

When a designer receives the design brief of a hairdryer, he / she needs to consider the following needs of users.

(a) Ergonomics

(i) How many users will be involved during the process?

(ii) How should the design deal with the hair drying process?

(iii) What other equipment will be used together during the process?

(iv) How comfortably, effectively and efficiently should the hairdryer work?

(b) Practicability

(i) How to put all the components in the hairdryer?

(ii) What size and materials of the hairdryer will meet the needs of users?

(c) Culture

(i) How should the appearance of the hairdryer be designed to attract users, e.g. shape, colour and visual elements?

(ii) How will the culture affect users in using the hairdryer in their everyday life?

(d) Emotion

(i) How should the interface of the hairdryer be designed to reflect the positioning of the product?

(ii) How will the image of the hairdryer, including the attractiveness of its appearance, interface, tactile feeling, etc., affect the emotional responses of users?

An example of a hairdryer

Relevant Knowlrdge

(2) Below the Line

During a design process, an engineer looks from a different perspective. He / She focuses on the production and usability of the hairdryer, and pay attention to the following.

(a) Usability

(i) Does the design work well with all the components in the hairdryer?

(ii) Feasibility of the production

(iii) Can the hairdryer be manufactured?

(iv) How effective and efficient is the production of the hairdryer?

(b) Technical safety

Does the safety standard of the hairdryer comply with the general safety standards and standards for electrical products?

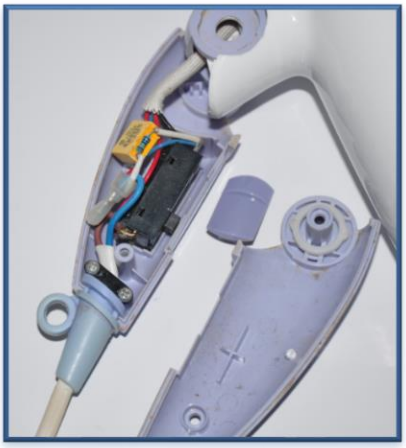
(c) Reliability

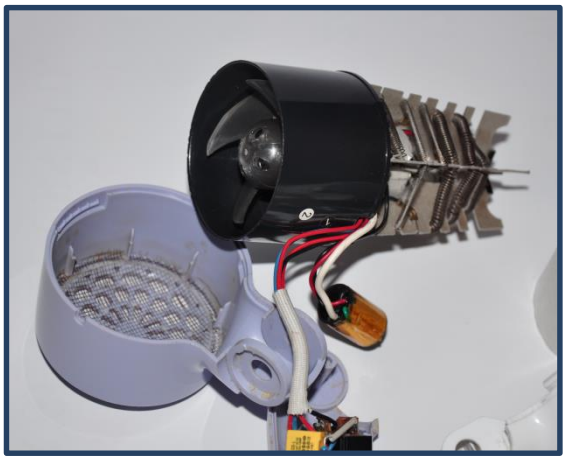
(i) How reliable is it to deliver the hairdryer from the factory to the users?

(ii) When used properly, how long is the service life of the hairdryer?

(d) Production costs

Do the technical issues, including factory, manpower, production methods, production equipment, materials used, assembly processes and packaging, fulfil the target production costs?





The electronic components and assembly parts inside a household hairdryer fulfil the international standards for electrical appliances.

Reflection Question:

At what product positioning of a hairdryer will the role of the engineer be more important than that of the designer? Why?

_____

_____

Relevant Knowlrdge

Case Study 5

BMW K Series Motorcycles

BMW introduced the motorcycle K1200LT in 1999 after its introduction of the K100RT in 1984. K1200LT was described as one of the most exquisite and luxurious motorcycles that had ever been produced. In the automotive industry, only a handful of companies are capable of making cars and motorcycles at the same time. In terms of technology, BMW believes that it is beneficial to both markets by sharing the technology. Undoubtedly, a 1200 cc motorcycle is gigantic. It possesses a 4-cylinder engine and an anti-lock braking system, which are common features for a car. With other luxurious equipment such as an adjustable electronic windshield and a 6-disc CD player, the K1200LT is one of the most well-equipped motorcycles in the world. The roles played by the designers and engineers during the design process of the motorcycle are, in fact, clearly defined according to the 'above / below the line theory'.

At the beginning of the project, the research team had devised a list that reflected what the market gap was. With the list, a clear specification about what consumers needed was shown. The design brief stated that the target was 'to design a powerful, well-equipped and comfortable motorcycle for the middle-class or above consumers'. Based on this consideration, engineers and designers formed a design team together with marketing specialists and other researchers.

(1) Below the Line

Engineers had to list out what technology could be used in providing sufficient power and enhancing the equipment for comfort, e.g. the entertainment system. In addition, as the consumers were from at least the middle class, safety was another important issue to be addressed. Considering all these requirements in the real environment, the engineers used various technologies and items to form the basic configuration of the motorcycle. Apparently, the most critical engineering parts were the engine and the transition system. The chassis of the motorcycle were built to possess high efficiency and performance. Here was where the line was drawn and the engineering section was below this line.

The chassis of the main body of the K1200LT was considered as 'below the line'

Relevant Knowlrdge

(2) Above the Line

Designers were committed to work on the outer casing of the motorcycle. With the basic chassis as the base, designers dealt with the form, space, control locations, comfort and style of the bike.

(a) Control interface – The visual indications on the control panel with a logical workflow and suitable feedback.

(b) Ergonomics – The control handles must be ergonomically positioned. The seat, back rest and foot pedals must also be placed at proper positions and made with suitable materials.

(c) Visual language – The form, shape, lines, colours and finishing must convey the message of a machine with high quality and reliability, and establish a powerful image.

(d) Corporate image – The above elements not only describe the motorcycle itself, but also match up with the corporate image of BMW on its auto series. On top of the establishment of a logo and symbol, it is an overall product strategy of the company.

Reflection Question:

In Hong Kong, the smartphone penetration rate is very high already. Comparatively, much less people are using smartphones in other parts of the world. What can designers and engineers do respectively if these markets are to be occupied?

Designers_____

_____

_____

_____

Engineers _____

_____

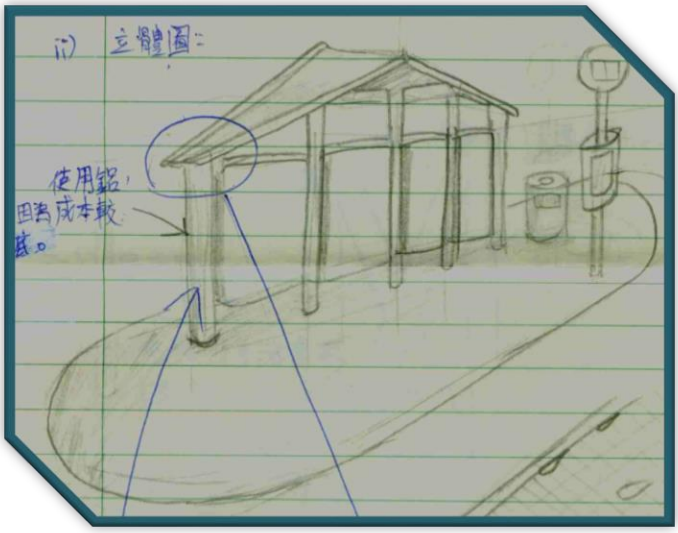
_____

_____

Relevant Knowlrdge

V Design presentation

How a designer demonstrates his / her proposals for product evaluation is very crucial, especially when the people involved in the evaluation process are not familiar with the drawing conventions used by the designer. Ideally, a product model that has a high resemblance to the real product could be shown. However, making such a model or a prototype is often costly. The following describe some ways of presentation.



A design sketch

1. Verbal Description

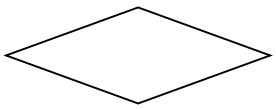
This method is cheap and useful, especially when presenting the operations and uses of a product. However, this method is not comprehensive.

2. Flowchart

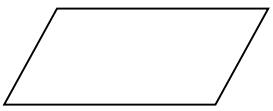
A flowchart is a symbolic representation of the stages or operations of a process. Each stage of the process is represented by a standard symbol. Flow lines are used to connect the symbols and arrows are used to describe the sequence of the stages.

Preparation
Indicates the beginning, modification or end of a flow

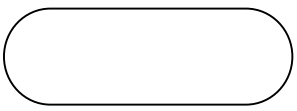
Process
Indicates the general components of a flow



Decision
Indicates a decision point between two or more paths in a flowchart



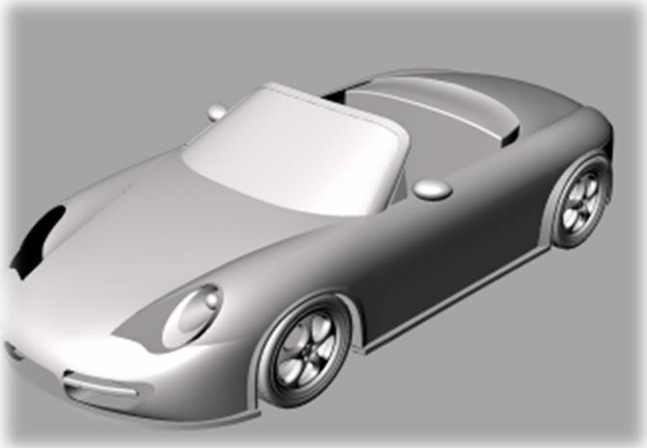
Input / Output
Indicates the addition or deletion of a process



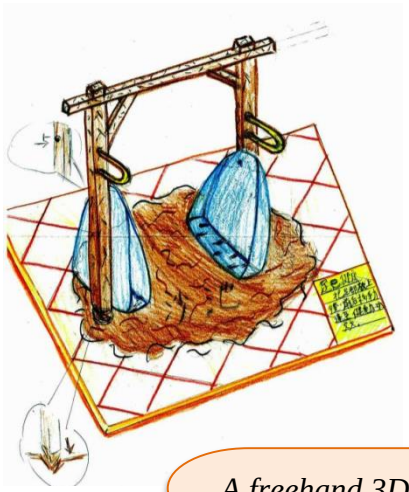
Terminator
Indicates a delay, stop or interruption of a flow

3. Realistic Illustration on Paper or Screen

A coloured hand-drawn 3D drawing can demonstrate a design vividly, but with the help of computer-aided design (CAD) software, in addition to a 3D colour drawing, we can also present some details, such as material textures, lighting effects, shadows and reflection effects on glass surfaces.



A 3D CAD drawing



A freehand 3D design drawing

4. Model

A real 3D model made of paperboard or cardboard is useful in demonstrating the design also. In some cases, a full-size model will be built, which are sometimes used as a prototype.

Materials used for making a 3D model

Other materials, such as styrofoam, modelling clay and plaster, are often used as well.

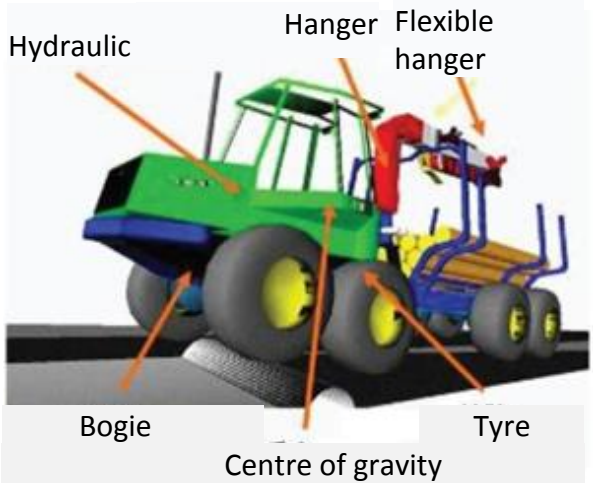
A mobile phone model made of high density polyethylene

Modelling by using clay to test for the feel of touch of pen shafts (Image source: 50 Products, RotoVision, p40)

A prototype of a bath made by plaster moulding

5. Virtual Prototyping

Virtual prototyping enables the display of animations, for example, the operation of a product, on a computer screen. Computer software can even simulate the handling of a product to test the reaction of the audience on the spot.



A 3D virtual model showing the major parts of a toy truck on a screen

Relevant Knowlrdge

6. Simulation

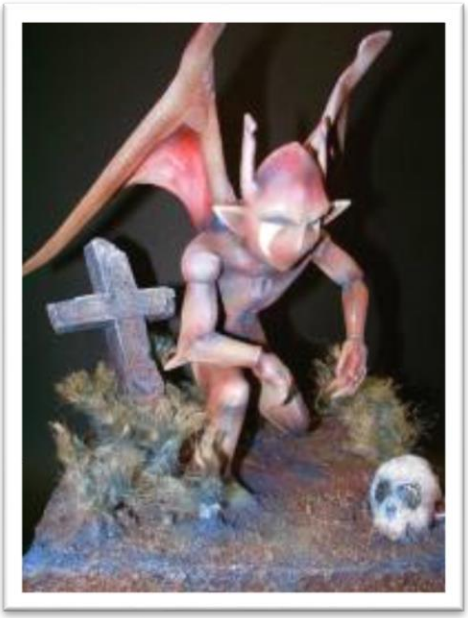
CAD software can be used to simulate and evaluate the performance of a product or a component of a product. Quantitative and qualitative information about the object, such as its bending load, can be acquired through mathematical methods. In general, computer-aided evaluation (CAE) refers to the use of a CAD model to test the performance of a product or a component through simulation. With CAE, engineers can obtain and analyse the test data, so as to minimise the material costs and improve the target performance of the product.

7. Rapid Prototyping

Rapid prototyping usually involves a variety of technologies. CAD data are transferred to a solid modelling machine to produce the prototype by stereolithography with the use of materials such as photopolymers, thermoplastics, waxes and heat-sensitive sheet.

Advantages of Rapid Prototyping Technology:

- Can create very complex shapes.
- Highly automated and thus has low technical requirements for the operators. It can even be fully automated without the need of manual operation.
- No need to make tools and moulds, and no need to use jigs and fixtures, thus saving time and effort.



A prototype of a game character

Remark:

Rapid prototyping technology, such as 3D printing, will be further discussed in a later teaching material.

Relevant Knowlrdge

VI Production Process in Various Fields

After a creation has been designed, we must go through a production process to form the product. The production team needs to consider the following aspects. If a problem cannot be resolved within a reasonable scope, a discussion with the designer should be made to modify and improve the design for fitting the production process.

Considerations of the production team:

- How to make each of the technological processes cost-effective
- Selection of appropriate tools and equipment, and application of proper skills to implement solutions to design problems
- Selection and application of appropriate methods of material removal and forming processes
- Selection and application of appropriate methods of joining materials or assembling components
- Selection and application of appropriate surface-finishing methods for aesthetic purposes, to maintain the appearance and prolong the working life of products for a reasonable period of time
- Use of a range of machines and new technology to enhance efficiency and effectiveness, and to reduce costs and time
- Proper arrangement of production processes and management of facilities and manpower

Remark:

The above points are discussed in various S1 and S2 teaching materials (refer to Materials 3, 4, 7 and 8 of S1, and Materials 2 and 5 of S2). It is time for students to recap the points.

Case Study 6

Design and Production of Water Taps

Let us explore these problems through the following case study.



The above three water taps have appeared in the case study of Material 4 of S1 resources. With the addition of the following three, do you find them very similar?



They have many common features:

Material	Bronze
Forming method	Casting
Structure	3 holes on the main body
Connection / Assembly method	Joining by screws
Surface-finishing method	Buffing / Electroplating

Relevant Knowlrdge

Suppose that you form a design and production team with two to three classmates and plan to design and make a new water tap. Before starting the design process, try to use your knowledge about materials, processing methods and surface finishing learnt from S1 till this material, as well as other useful information obtained from various sources, to find out the reasons of the following.

Why are / do they:

	Because
1. made of bronze?	
2. made by casting?	
3. have three holes on the main body?	
4. use screw threads for joining?	
5. use buffing / electroplating for surface finishing?	
6. look alike?	

When re-designing the water tap, in what ways do you think breakthroughs can be made? Why?

Diagram	Reasons

Similar Case Studies

Students can also conduct similar studies.

In fact, if students give some thoughts and research on every product they pick up or see, they will have a better understanding of manufacturing processes in different areas.

For example, apart from a wide range of sizes and colours, handbags used by ladies have a lot of similarities.

	Because
1. Made of _____	
2. The main body is _____	
3. Assembled by _____	
4. Often added with _____	
5. _____	
6. Brand handbags will usually show their brand names at a conspicuous position.	
7. While the appearances are similar, their prices can have a hundredfold or a thousandfold difference.	

VII Glossary of Terms

Intellectual property	知識產權	Virtual prototyping	虛擬原型
Copyright	版權	Rapid prototyping	快速原型
Patent	專利	Creative commons	共享創意
Trademark	商標		
Registered	註冊		

VIII Interactive Information

	Website	Content
1	http://www.51zbz.com	Standards download
2	http://tds.ic.polyu.edu.hk/ds/pd/06_production/index.htm	Design and production
3	http://www.doc88.com/p-602824454833.html	BS 8888
4	http://www.hkliberalstudies.com/modules/knowledge/index.php?pa=viewads&lid=785	Drug patent controversy
5	http://tds.ic.polyu.edu.hk/mtu/atm/3dp/index.htm	Rapid prototyping technology
6	http://hk.creativecommons.org/	Creative Commons Hong Kong
7	http://commons.wikimedia.org/wiki/Main_Page	Wikimedia Commons

Case Study

The Technology behind Game Console

In the following case study, you will act as a technical consultant and provide opinions on the development of a solution for enhancing learning effectiveness through e-learning.

Objective:

This case study provides a platform for you to study the important issues related to the technologies involved in game consoles from multiple aspects, including social, ethical, commercial and technological. Through the learning activities in this case study, you will have the opportunities to explore the development of the technologies, as well as how this knowledge promotes Hong Kong's economy.

1. Background

Are you one of the fans, who queue till midnight to get hands on a newly announced game console? Have the revolutionary features and enhancements in these new game consoles attracted you? Underlying these features and enhancements are cutting-edge technology that the game console manufacturers developed to attract the game players.

Nowadays, video game represents a significant amount of business and revenue in a number of countries. Thus, it attracts quite a number of companies to develop products in this area and hence creates severe competition among them. To withstand the competition, manufacturers establish advanced research-and-development laboratory for game technology and result in new technological developments. These technologies are very often cutting-edge technology that are invented originally for playing video game before a number of them find their ways into other mainstream electronic products. For example, 3D video cards were called graphic accelerators, which were invented for playing game in PC and they are now found in every Personal Computer.

Not only these cutting-edge technologies find applications in other electronic product, people discover the video game itself is a good means to facilitate student to learn.

For further information, you may refer the articles in the following two websites:

1. Video Games: Serious Business For America's Economy

   http://www.theesa.com/newsroom/seriousbusiness.pdf

2. Games based Learning: Serious business applications:

   http://www.pixelearning.com/docs/seriousgamesbusinessapplications.pdf

Case Study

2. The Case

In this case study, you are supposed to be a technology consultant of an electronic learning solution provider. You are responsible to submit a government project proposal on behalf of your company, which requires the development of a solution on using electronic methods to help student learn better. As you are aware of

- the importance of game technology and its potential applications to motivate student to learn.
- motion sensing game controller is popular among the young generation

In your proposal, you suggest to use game console with motion sensing game controller from a local manufacturer (http://www.sengital.com) as the basis of your solution**.** After submitting the proposal, the government officials will call a meeting to discuss your proposal before they decide whether they accept your proposal. You are also advised that the following will be discussed in the meeting, including

- Given there are some limitations with the technology, is it good to use motion sensing game controller?
- Why the product from the local manufacturer is proposed?
- Why not to use mouse as it resembles the traditional ways of using computer?

Your boss asks you to seriously carry out a study before attending the coming meeting. He also tell you that one of his friends, who is a key member of parent association, express that a few parent associates will also be invited to the meeting.

3. Activities

a. Self-assessing Question 1 – Basic Understanding of Game Console

In this class activity, you are required to extend your understanding of micro-controller to a special type of micro-controller based system, namely video game console. Before you answer the question in the following worksheet, try to think about what is happening "inside the box" when you play game with video game console. Alternatively, you may relate the Resource Material in topic 3.3.1 to 3.3.3 of the Electronic Module to the information from the following websites:

1. How Video Game System Work?

http://electronics.howstuffworks.com/video-game3.htm

2. How Joysticks Work?

http://www.howstuffworks.com/joystick.htm

Case Study

b. Self-assessing Question 1

Basic Understanding of Game Console Construction

1. What are the four main components of a computer?

2. In most consoles, it has a special integrated circuit to draw objects on the screen. How do people usually call this an integrated circuit? Which main component of a computer does it correspond to?

3. A personal computer is also required to draw objects on its screen. Is there any difference(s) between such integrated circuit for personal computer and that for a game console?

4. Which part of computer do joystick in game console have similar function?

5. Why does a typical personal computer not come with a joystick?

6. What is (are) the shortcoming of a joystick?

7. Give some examples of game controller that you think it could perform better than a joystick. In what way it is better than a joystick?

Notes and remarks:

1

2

3

4

5

6

7

Self-assessing Question 2 – Motion Sensing Game Controller

Most members in the meeting, including the parent association representative, the government officials are all laymen to technology. They do not understand technology well but are very profit conscious. In the meeting, you are required to provide a concise presentation on the technology driving the motion sensing game controller. Otherwise, they won't be able to appreciate the benefit of the employing technology in this technological advanced society. To facilitate your preparation of this part of presentation, please answer questions on the following worksheet. For this purpose, you may relate your understanding of section 3.3.5 of the Electronics Module (Simple Interfacing) to the information from the following website:

1. How do motion-sensing video game controllers work?
   http://scienceline.org/2006/12/18/motioncontrollers/
2. How does an accelerometer for Nintendo Wii work?
   http://wiki.answers.com/Q/How_does_an_accelerometer_for_Nintendo_Wii_work
3. The technology behind the Wii MotionPlus
   http://arstechnica.com/gaming/news/2008/08/wii-motion-sensor.ars
4. Designing games for the Wiimote
   http://www.develop-online.net/features/58/Designing-games-for-the-Wiimote

Case Study

c. Class Activity 1 – Basic Understanding of Motion Sensing Game Controller

Motion Sensing Game Controller

1. What is the function of a game controller?
2. What kind of problem wills a motion sensing game controller is intended to solve?
3. Why the problem mentioned in answer (2) is so important?
4. What kind of game are motion sensing game controllers made for?
5. What is the key technology used in a motion sensing game?
6. What is the essential function of this key technology in a motion sensing game?

Notes and remarks:

1

2

3

4

5

6.

Class Activity 2 – Product analysis

Case Study

Product analysis

You are asked to compare two designs of motion sensing game controllers.

1) Arrange yourself into group of five students.

Analysis each alternative (traditional computer mouse, Wiimote, and your suggested motion sensing game controller) and write down the advantages and disadvantages concerning the following factors: (i) easy to use, (ii) cost, (iii) features, (iv) potential problem and any other factors that your group feel it is worth to consider

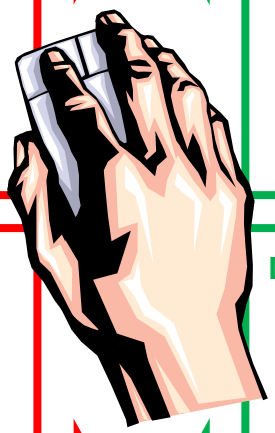
Ease to use

Mouse

Your company's suggestion

Advantages:

Advantages:



Disadvantages:

Disadvantages:

Case Study

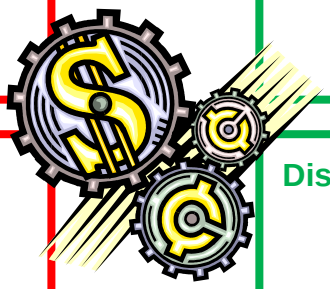
Cost

Mouse

Your company's suggestion

Advantages:

Advantages:



Disadvantages:

Disadvantages:

Case Study

Features

Mouse

Your company's suggestion

Advantages:

Advantages:

Disadvantages:

Disadvantages:

Case Study

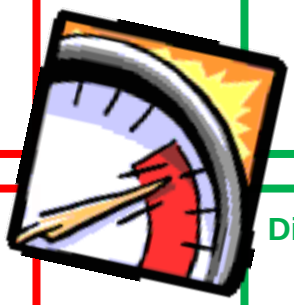
Potential Problem

Mouse

Your company's suggestion

Advantages:

Advantages:



Disadvantages:

Disadvantages:

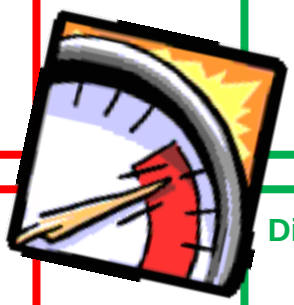
Case Study

Mouse

Your company's suggestion

Advantages:

Advantages:



Disadvantages:

Disadvantages: