Design and Applied Technology

(Secondary 4 - 6)

Learning Resource Materials

Strand

I

Design and Innovation

Design in Practice

Design Considerations

Design and Communication

Design and Applied Technology

(Secondary 4 – 6)

Compulsory Strand 1
Design and Innovation

[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

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PREFACE

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.

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INTRODUCTION

The development of a design is by no way a coincidence. The design process nurtures a design from research, conceptualization, development to presentation and realization. Some of these steps are necessarily done by designers, such as the conceptualization and development. Ideally, a designer should follow through the whole process. However, noting that the development of a design requires other knowledge such as engineering and marketing, the understanding of design fundamentals enables a designer to create a design.

Creativity, to laymen, is individualistic. However, in real terms, creativity often is a product of teamwork. Through team-working, creativity is often inspired by interaction among team members. Many design companies purposely demolish the physical divisions, such as panels and walls, among designers to enhance interactions.

Design is about solving problems, whether it is physical, practical or psychological. Before starting to design, identifying what we face is the key point to make a smooth beginning. Problems, when considering people, are ignited by human's needs. A need is normally not obvious at all and requires investigation. During the process, factors listed below must be determined:

(a) What is the major problem found in the existing design (e.g. a product)?
(b) Will the problem be originated from certain needs of the users?
(c) Will there be other users, environment and product standards needed to be addressed during the process?

As the tasks (or problems) are clearly identified, a design brief will be naturally formed and the follow-up procedure is quite straightforward, including presentation of the design idea to the client for acceptance.

After the design idea is being accepted by the client, it will be put into production. The process involves heavy communication between groups of people – the designers, the clients and the engineers. Therefore, it is significant that the designer is able to realize her/ his ideas

into visual forms. These visual forms should be accurately represented to avoid misunderstanding by any parties.

Modern technologies enhance the presentation of design ideas. For instance, a 3D printer realizes a 3D digital design into a physical form. Modern designers have a wider range of presentation media in that perspective. It should be noted, however, that an adept designer does not rely solely on modern technologies. Sketch is often employed as a communication medium when the designer is in the preliminary or developmental stages of a design process. The best visual presentation, as such, should be able to communicate thoroughly the idea of the designer to other parties, regardless of its physical form.

In view of the above major aspects for Design and Innovation, this strand focuses on the design process which includes researching and identification of design, development of the ideas and presenting ideas. It also aims at helping students develop an understanding of design principles for product and communication of ideas.

CHAPTER 1 – DESIGN IN PRACTICE

This chapter covers topics on:

1.1 Design Fundamentals,
1.2 Design Process,
1.3 Creativity in Design,
1.4 Project Management and Teamwork, and
1.5 Roles of Designers and Engineers

These topics include learning materials and activities that facilitate your:

(a) understanding and application of the fundamental elements for a design;
(b) understanding and execution of a design process;
(c) understanding of the different thinking pathways to arrive at a creative design;
(d) selection of a suitable thinking pathway to create a design;
(e) understanding and application of management skills on the project;
(f) understanding of how a project team works through the design process; and
(g) understanding of the difference in the roles of Designers and Engineers.

The development of a design is by no way a coincidence. The design process nurtures a design from research, conceptualization, development to presentation. Some of these steps are necessarily done by designers, such as the conceptualization and development. It will be best if a designer can follow through the whole process. Understanding the design fundamentals is also important because it gives the designer a backbone in creating design.

Creativity, to laymen, is individualistic. However, in real terms, creativity is often a product of teamwork. Through team-working, creativity is often inspired by interaction among team members. Many design companies purposely demolish the physical divisions, such as panels and walls, among designers to enhance interactions. In this chapter, the concept of teamwork will be introduced and explained.

1.1 DESIGN FUNDAMENTALS

A basic design element is the basic visual or physical form that a designer uses in his creations. Such elements in a design are like bricks of a building or fabrics of a piece of cloth. For instance, a curve line may have different visual forms and meanings when compared to a straight and linear line.

Therefore, a designer should be more sensitive to the ways these elements are being put together. The designer must, therefore, be adept at using them for specific purposes. These are discussed in greater detail in organizational principles and compositions.

We are living with forms around us. There are natural and artificial forms.

Figure 1.01 Flower is a commonly-found natural form

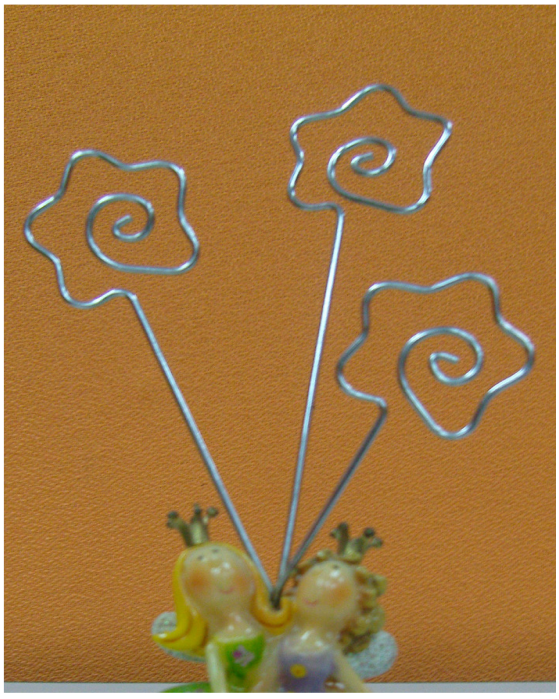


Figure 1.02 An artificial form – a floral-pattern

The basic design elements are point, line and plane. The 3-Dimensional (3D) form is the primary identifying characteristic of a volume. A volume is the products of points (vertices), lines (edges) and planes (surfaces). The commonly-seen 3D forms are point form, linear form, planar form and solid form.

Anything that is visible has a shape. Shape is the outward appearance of things seen. Shapes can be either 2-Dimensional (2D) or 3D.

1.1.1 The Visual Design Elements of Form

A. Point

In geometry, points are imagery per se. A point indicates position. It has no length or breadth. It is both the beginning and end of a line, and is where two lines meet or intersect.

A point is not visible until it moves to form a trail or expands so large that it becomes physically visible to the human eyes. In such cases, the point becomes a dot, a line or shape. Modern designs often refer dots relative to its context. A small window on a big building can be referred to as a dot. A polka dot on a dress is called dot despite its relatively big size.

Dots have different characteristics. The shape of a dot can be round, square, triangular or even irregular. A dot is the most passive element of all. It does not convey a message on its own. Until more dots come together within a boundary, they start to emit visual meaning (Fig. 1.03) or create visual path tension through size difference and different distance between each other.

Figure 1.03 A dot is passive and meaningless. It becomes more visually meaningful when more dots gather.

Figure 1.04 The dots on a watch display the time.

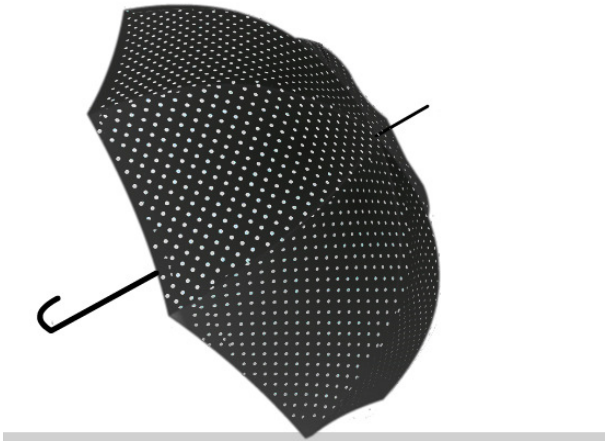


Figure 1.05 Polka dots give vitality to the umbrella.

B. Line

In geometry, a line is a trail created by a moving point. A line has length but no breadth. It has position and direction. It is bound by points. It forms the border of a plane.

A physically visible line can be characterized by movement, direction, thickness and texture. There are different emotional expressions with different lines (Fig. 1.06, 1.07).

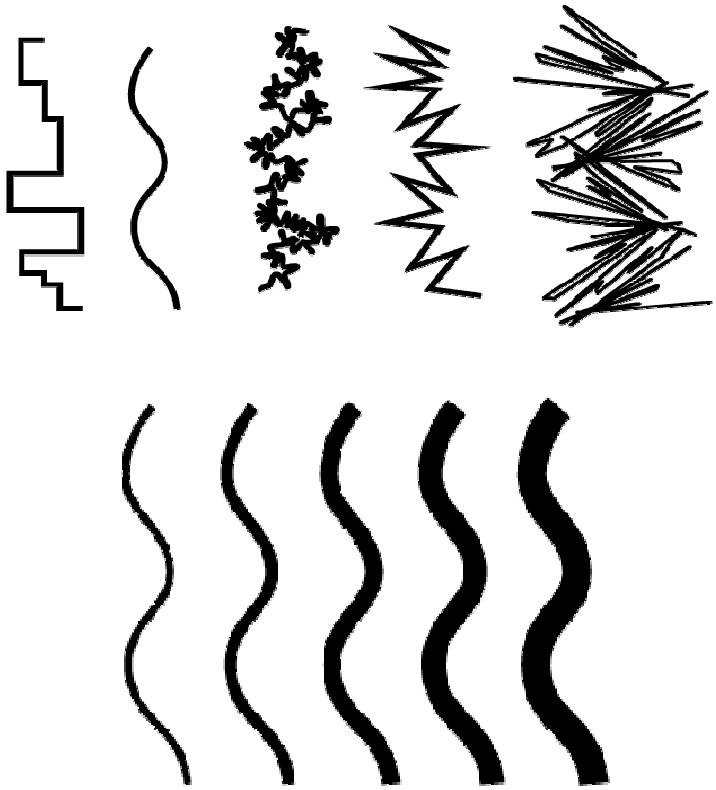


Figure 1.06 Different thicknesses of the same line express different strength and elegance.

Figure 1.07 Different textures express different visual qualities, hence personalities.

Designers often use lines in their design to convey meaning (Fig. 1.08). Wavy lines are for dynamism and vitality; straight lines for formality and modernity; and jaggy lines for erosion and agitation.

Figure 1.08 Architect Frank Gehry's witty use of wavy solid form in Guggenheim Museum expresses movement and dynamics.

Figure 1.09 Lines on a suspension bridge create sense of tension.

C. Plane

In geometry, a plane is formed by line in motion. A plane has length and breadth, but has no thickness. It has position and direction.

A physically visible plane is used to create a 2D configuration through an enclosed area with length and width.

Several physically visible planes are used to create a 3D configuration or enclosed space to create a volume through length, width and thickness.

Figure 1.10 A traffic sign illustrates the 2D planar form.

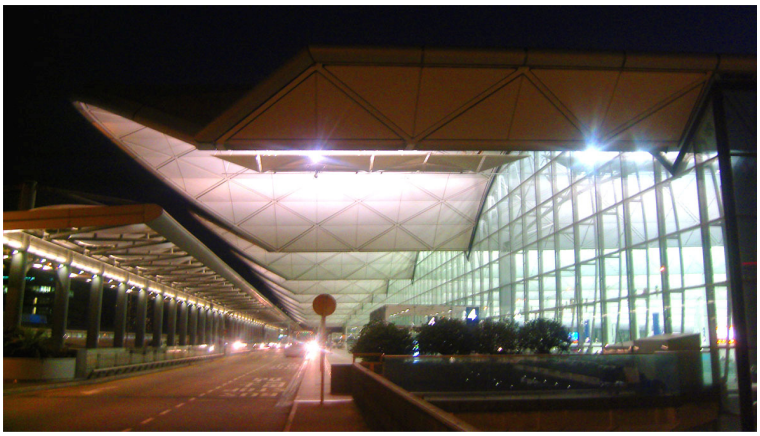


Figure 1.11 The corrugated roof of the Hong Kong International Airport illustrates the 3D planar form.

Thus, the relationship of point, line, plane and shape can be explained by the following diagrams.

Figure 1.12 Movement of a point forms a line

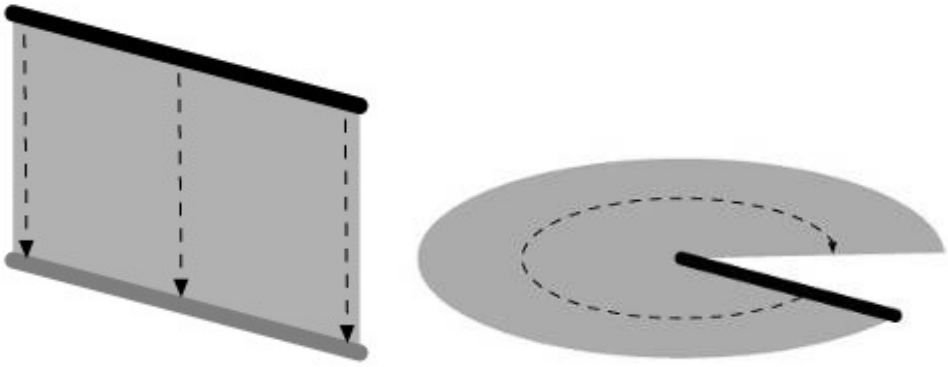


Figure 1.13 Movement of the line forms a plane

D. Shapes (2D and 3D)

Shapes can be 2D or 3D. It describes the appearance of a plane or object. In a design, the most observable element is usually the shape. Shapes can be *concrete* or *abstract*. Concrete shapes are often close resemblances of the original images. These shapes are very informative, but leave little room for imagination. Great details are depicted to enhance the reality of the image concerned (Fig. 1.14, 1.15). Abstract shapes, on the other hand, are often conceptual representations of the original images (Fig. 1.16). Designers often use method of *deduction* to create abstract shapes. Abstract shapes are more provoking and actively involve the viewers in interpreting them.

Figure 1.14 Concrete shape: A logo shows the skeleton of a guitar.

Figure 1.15 Concrete shape: A logo uses a concrete 2D graphics of an apple.

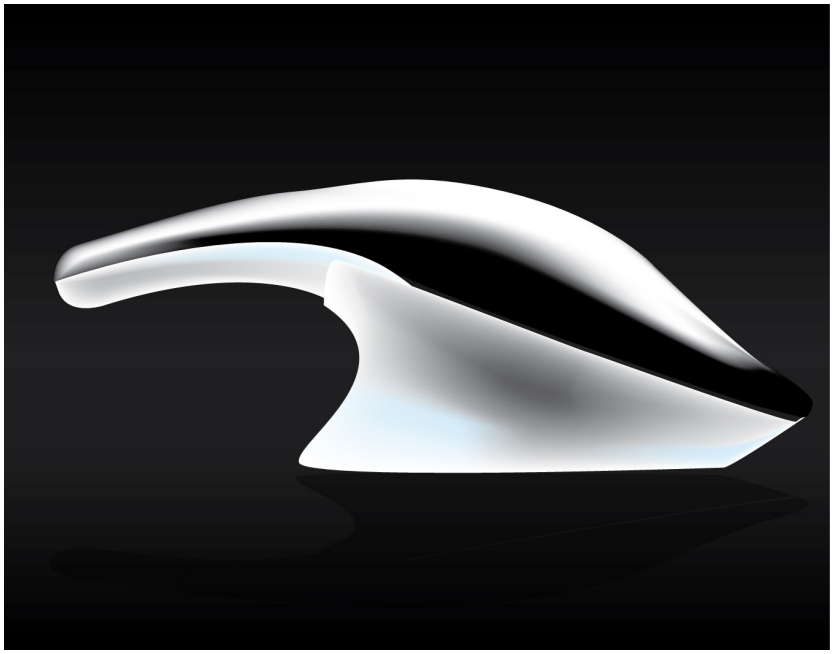


Figure 1.16 Abstract shape: This design of this vacuum cleaner resembles a sleek mini spaceship. It is an example of product semantics to interpret the excellent suction air flow dynamic and futuristic sense of this vacuum cleaner.

i) Geometric shapes

Rectangles, triangles and ellipses are often basic geometric shapes used in a design. Geometric shapes are more *refined* and *cultivated* than organic shapes because they are precise, measurable and organized. Famous architect Leoh Ming Pei uses a lot of triangles in his designs (Fig. 1.17, 1.18).

Figure 1.17 The Louvre Pyramid, Paris

Figure 1.18 Bank of China Tower, Hong Kong

ii) Organic shapes

Contrary to geometric shapes, organic shapes are more random. They can be angular, jaggy or wavy edge. If geometric shapes are more precise and mechanical, organic shapes are more imbalanced and humanistic. These shapes are more fluid, lively and natural. They often suggest touches of nature (Fig. 1.19).

Figure 1.19 Student work: 2D organic shapes are placed on top of an umbrella, making it more lively and joyful to use.

Figure 1.20 Luigi Colani's Concept Truck-3D organic shapes

E. Volume

A volume is formed by the movement of a plane three-dimensionally or enclosure of planes creating a negative space, as illustrated in Figure 1.21 below.

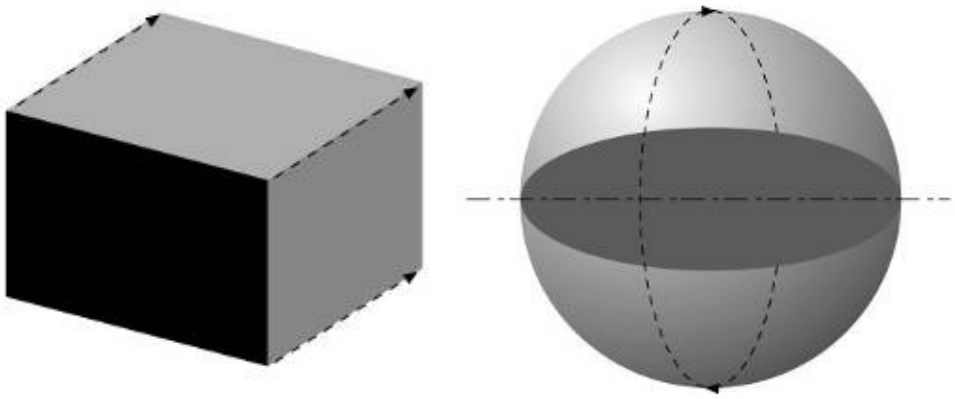


Figure 1.21 Movement of the plane three-dimensionally forms a 3D shape

Therefore, a volume can be either *solid* or *hollow*. A volume is often expressed as a form in design. A solid form possesses qualities, such as colour, tactile texture and mass. Further discussion of tactile texture is available at Topic 1.1.6 Texture. Solid forms in our daily life are architectures, sculptures, products and natural objects, such as rocks, trees and ice cubes (Figure 1.22).

Figure 1.22. Man-made and natural objects, such as building and ice cubes respectively, are examples of solid forms.

Hollow forms are often referred to as space. A carton box, for example, is formed by the enclosure of six rectangular planes. Interior spaces, in the same line of thinking, are created by the enclosure of concrete walls or glasses.

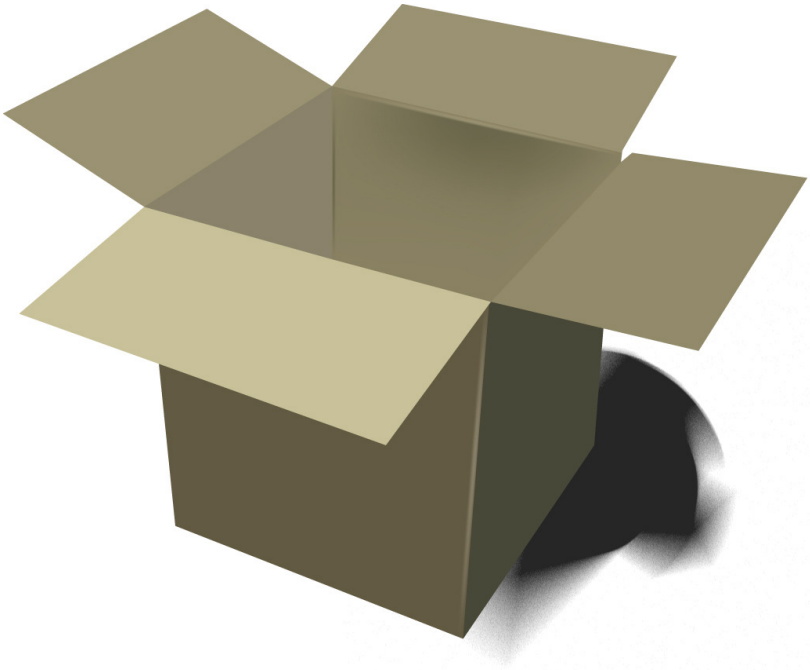


Figure 1.23.Forming space by enclosure of planes.

There are several ways to create a form. A form can be a point form, a linear form, a planar form or a solid form. A point form is created when points are arranged to give an impression of a form. Different lines meet at the vertices to form a cube – a real-life example is a mice trap, which is formed by metal wires that meet at different vertices. We call it a 'linear form'.

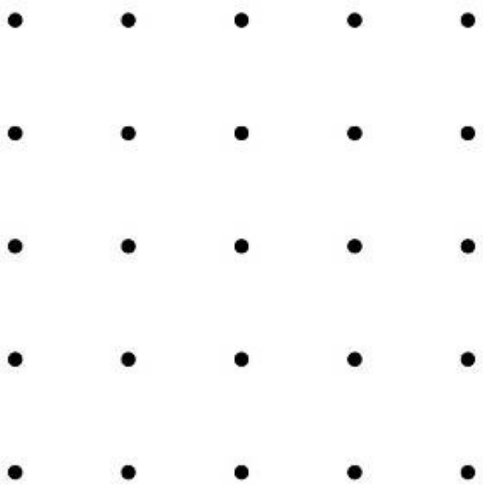


Figure 1.24. A point form is created when points are arranged to give an impression of a form. In the example above, an impression of a square is created.

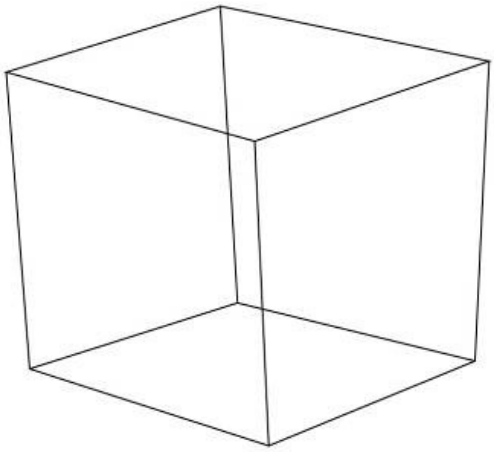


Figure 1.25.A linear volume formed by lines meeting at the vertices.

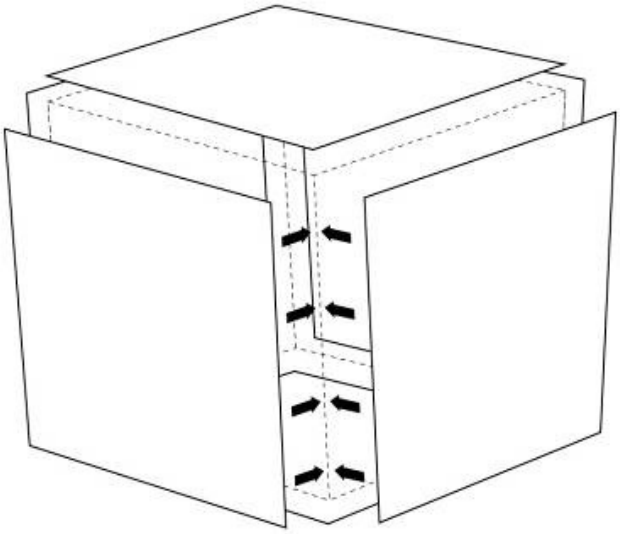


Figure 1.26.When different planes enclose to create a form, it is called a planar form.

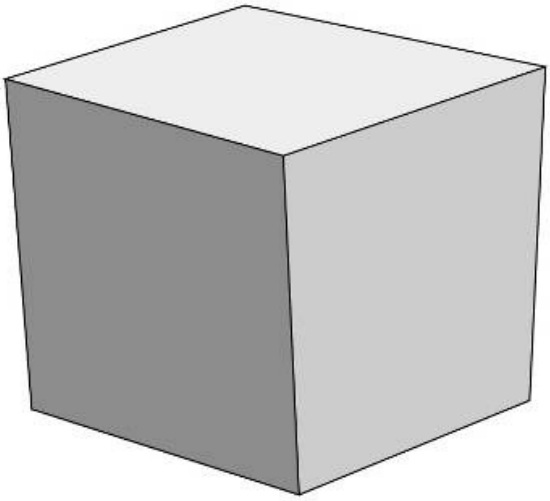


Figure 1.27 A solid form possesses colour, tactile texture and mass.

1.1.2 Composition

A composition arranges 2D design elements in a meaningful way so that it conveys what the designer wants to express. The term *composition* is often used in 2D design, whereas *structure* can be used in 2D and 3D design at the same time. The structural lines in a composition decide how the composition looks like and how the 2D design elements fit into them. Structural lines can be visible (Fig. 1.28) or invisible (Fig. 1.29), depending on the conceptual or aesthetic need of the design. For ease of reference, structural lines are visible in the following illustrations.

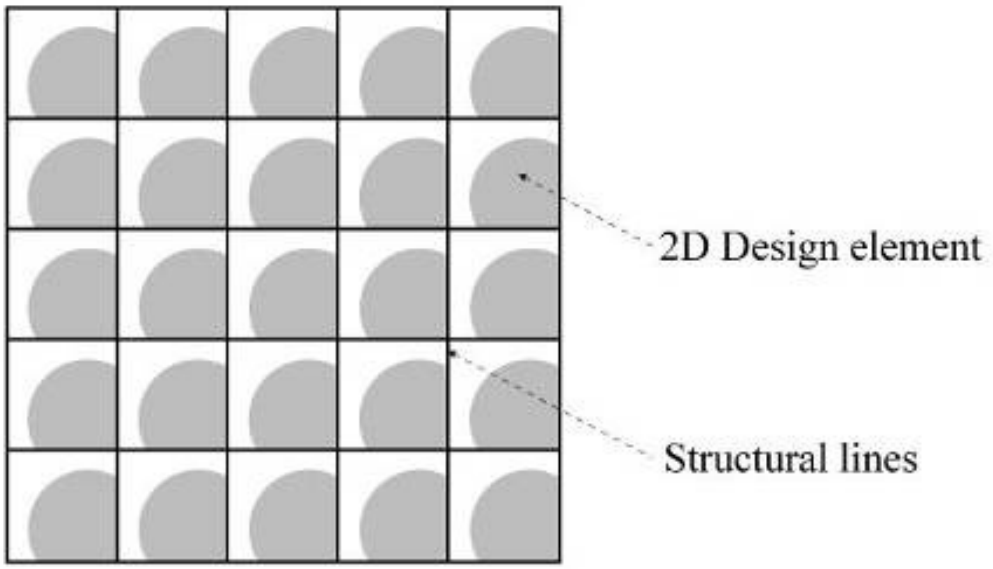


Figure 1.28 Structural lines and 2D design elements in a composition

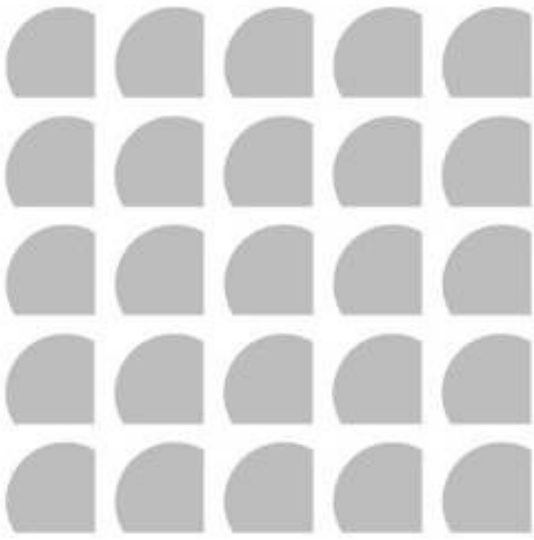


Figure 1.29 Same composition without visible structural lines

There are two main types of compositions, namely, *formal* and *informal*.

A. Formal composition

i) Repetition

Equally spaced, all the structural lines of this type of compositions are at the same distance from their adjacent lines. However, one must note that it is not a necessity for the 2D design element to be the same in terms of size, colour and spacing.

The structural lines do not, of course, necessarily have to be straight lines. They can be curve or zig-zaggy, depending on the need of the design.

A repetitive composition is usually monotonous and lacks variation. However, it is not a harsh and hard rule that repetitive compositions are monotonous. As with the example shown below, the change of the 2D design element within the composition produces visual excitement (Fig. 1.30).

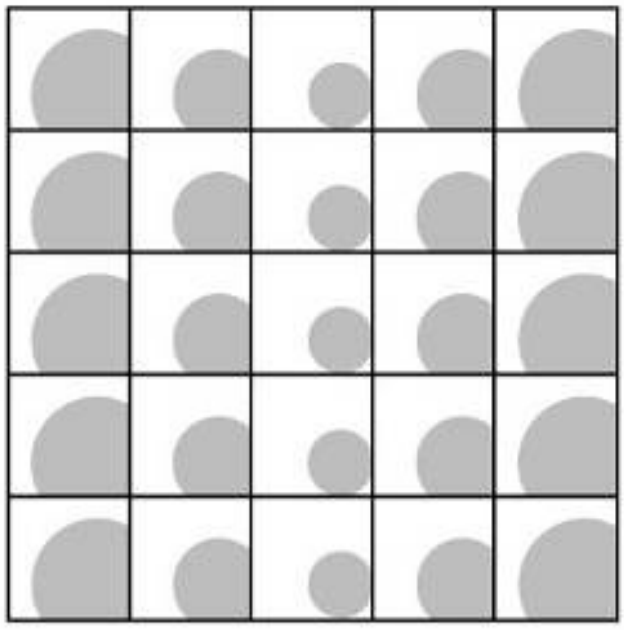


Figure 1.30 A size-varying 2D design element within a repetition composition

Figure 1.31 The neatly arranged round windows of the Jardine Centre in the Central District form a formal repetition.

ii) Gradation

A gradated composition has structural lines that are changing at regular and rhythmic pace. The change can be distance, angle or both. The gradated composition produces a sense of movement, vitality and breaks monotony (Fig. 1.32).

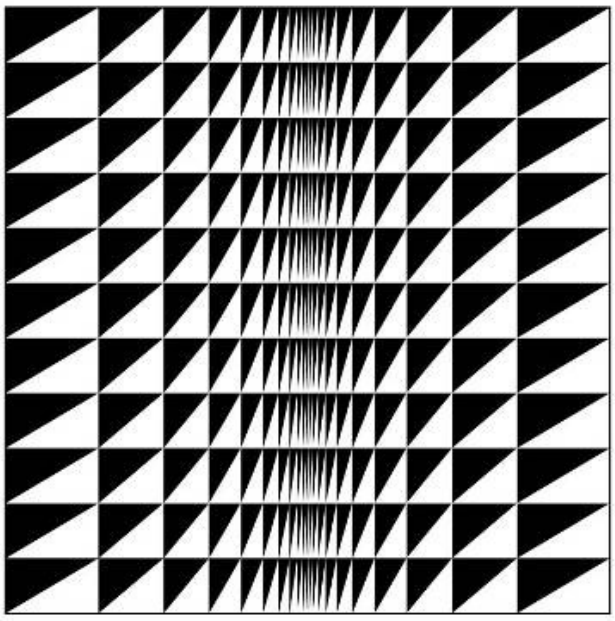


Figure 1.32 A gradated composition pattern produces a sense of movement, vitality and breaks monotony.

Figure 1.33 The telescopic view of a shell forms an interesting gradated composition.

iii) Radiation

A radiated composition has structural lines that are radiating outward from a centre point. Sometimes, there are two or more centre points producing further visual interest. Radiated composition is out-reaching, energy-releasing and is often used for association of dynamics, power and explosion (Fig. 1.34).

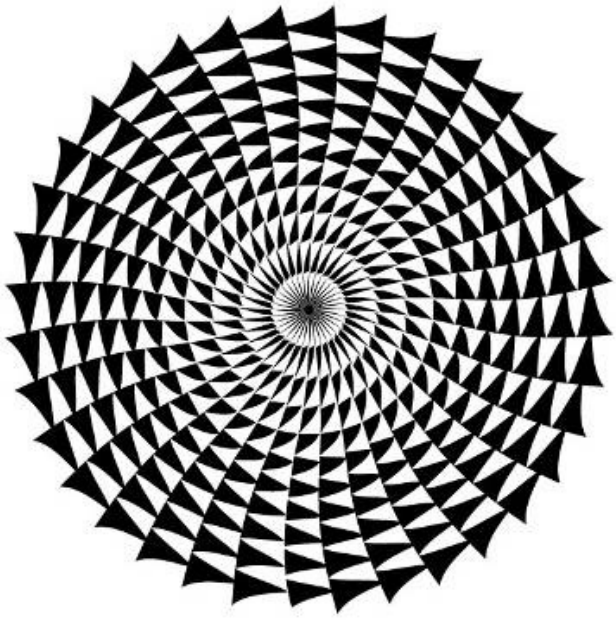


Figure 1.34 Radiated composition is out-reaching, energy-releasing and is often used for association of dynamics, power and explosion.

Figure 1.35 Miyakonojo Civic Center in Japan, 1966. Fascinating architecture, fan-shaped building decorated with radial steel frames

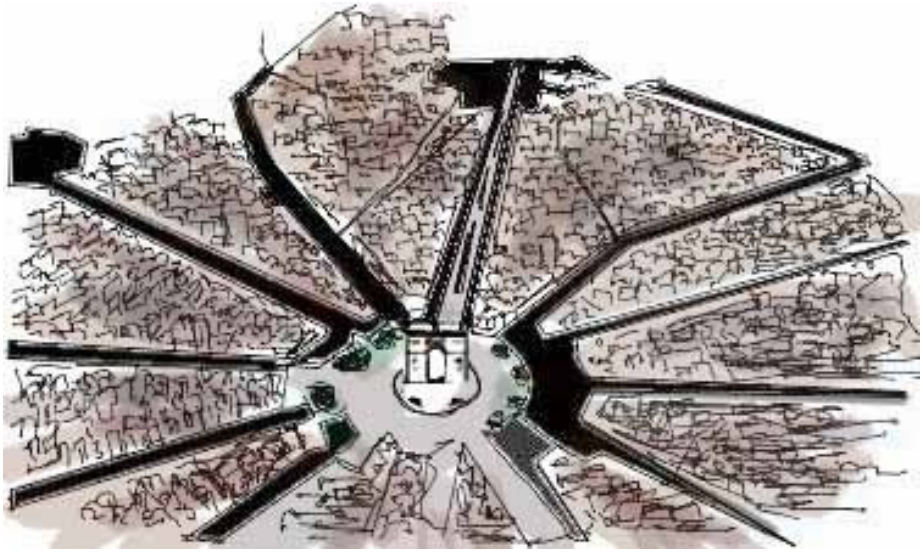


Figure 1.36 Aerial view of Paris (in sketch). The roads extend from the Arc of Triumph, forming a radiating pattern.

B. Informal composition

The 2D design elements in an informal composition are placed usually randomly without any structural lines. The 2D design elements can vary in size, angle, distance from one another and colour. However, there are often differences in density when 2D design elements are placed against each other. These differences in density, in turn, create focal points in the denser areas (Fig. 1.37).

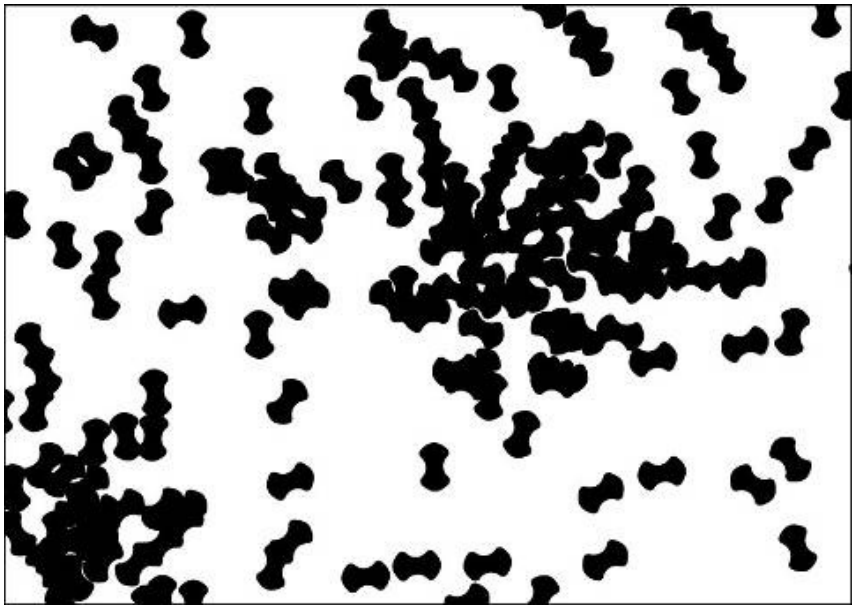


Figure 1.37 The denser areas become focal points for the viewers.

1.1.3 Organizational Principles

A. Symmetrical balance

In a symmetrical-balance design, the design element is repeated or reflected along a vertical or horizontal axis, giving the viewer a sense of permanence, stability, strength and formality (Fig. 1.38). It is also the easiest kind of organizational principle to be understood. Many buildings, products or graphic designs are established under this principle.

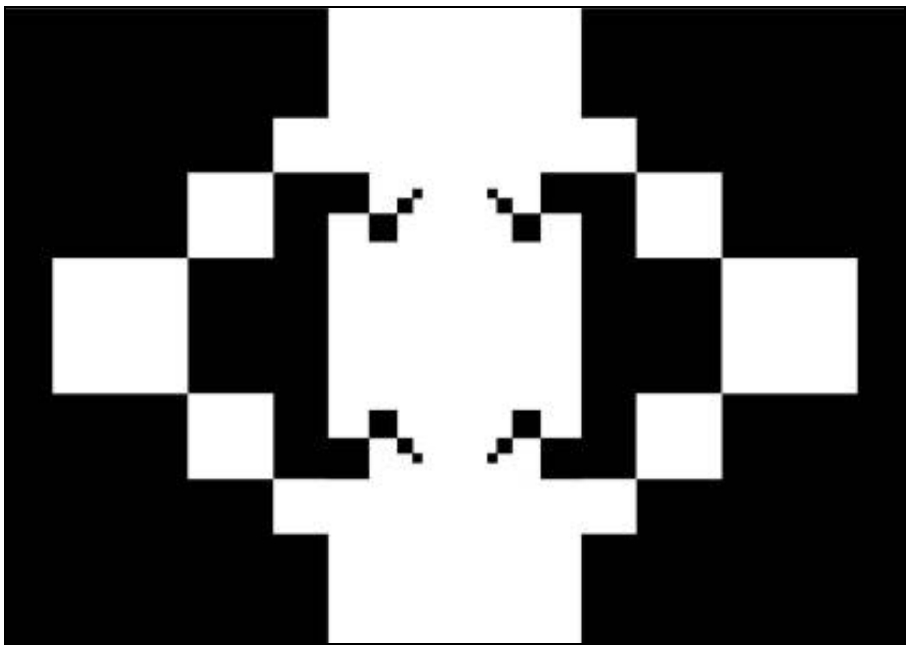


Figure 1.38 Symmetrical composition

Figure 1.39 An example of symmetrical design

B. Asymmetrical balance

An asymmetrical balance design is based on the *attractiveness* of the design elements on both sides of a composition. The qualities for attractiveness can be colour, texture, material of the design elements. Thus, a composition with very different sizes in design elements can be balanced off by a brightly coloured smaller element. Furthermore, complexity, density and position of the design elements account for the aesthetics of asymmetrical balance. Unlike a symmetrical balance where an axis can be drawn, there is no visible or measurable axis in an asymmetrical balance (Fig. 1.40).

Figure 1.40 A tower crane is an example of asymmetrical balance design.

C. Unity

Unity is a way to achieve harmony in a design. The design elements within a unity design do not necessarily have to be the identical. They can vary in shape, size, colour, material or texture, yet maintaining one or two properties alike to coordinate with each other. Each design element complements the other in a way that none will be a focus, but the whole design becomes the single important element. Unity in design often creates sense of harmony.

Figure 1.41 Despite the class differences, there are similarities in the design that unite these BMW sedans.

D. Focal point

A focal point in a design is necessary to attract attention. Quite unlike unity, a design with a focal point often has a single design element that stand out from the rest. This is achievable through varying a design element in shape, size, direction, colour, material and texture. A focal point emphasizes the difference in quality between design elements. Hence, a design with focal points tends to be energetic and proactive in grabbing attention. However, one must realize that a definite focal point is not a must in creating a successful design. It is only one of the many ways to achieve a good design.

Figure 1.42 The Sense of Design by using colour against a black-and-white background to create a focal point in the design.

E. Rhythm

Rhythm is an organizational principle based on repetition. However, repetitive compositions mostly result in unity. A rhythm design goes further as to create gradual changes, be it regular or irregular, in the design elements. The rhythmic and gradual changes are often dynamic and break the monotony of strict repetitive pattern. Shape, size, direction, colour and texture of a design element can be chosen to create gradual change.

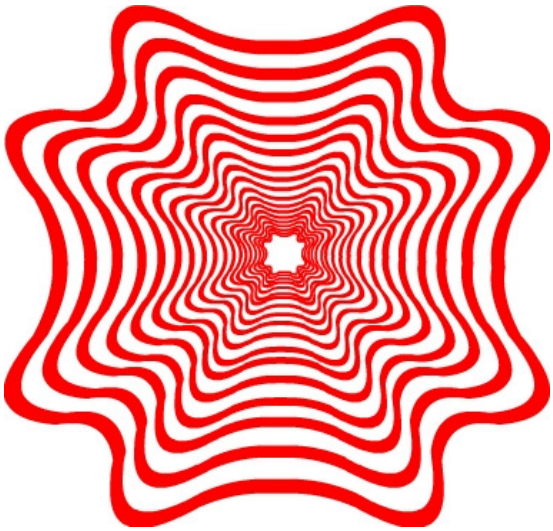


Figure 1.43 2-D form with rhythm.

Figure 1.44 The famous Taipei 101 Tower shows the use of repetitive architectural structures to achieve sensation of rhythm.

1.1.4 Colour

Colour is an influencing factor in most consumer purchases. The colour of a T-shirt, electrical appliance, tableware, wallpaper, toy, car, etc. is a major, if not the only, consumer concern.

Colours have also been associated with emotions often. In poetry, music, visual art and design, there are descriptions like, blue as moodiness, red as agitation and highly charged-emotion, green as fresh and vitality, black as death and emotionally detached, white as purity and divinity. A designer should be able to create a psychological linkage between the colours of a design and the consumers.

A. Properties of colour

Colour is a science in its own right, but the designer's concerns are more on visual characteristics, emotion and the visual phenomena of it.

i) Hue

Hue can be referred to as the name of a colour. Hue describes the visual sensation of a colour. There are good variations of hue when a colour shifts towards its neighbouring colours. The hue orange has different visual representations in different people, places and even time. It is very hard to draw a common ground for reference by different people.

Also, there are numerous variants in between two hues. For instance, the hue 'red' becomes pink, rose, scarlet, maroon, crimson or burgundy when it changes its location between red and blue. In commercial practices, colours are even more romantic as can be. Navy blue, desert sunset, orchid yellow, ultra-marine, you name it. Moreover, there is no standard colour naming system in academia and industry that can establish a common name for the same colour. The one that is widely accepted today is the Pantone Colour System, but the naming of the colours is alpha-numeric only. In summary, the naming of colour is arbitrary and based more on the emotional qualities expressed by the colours.

However, there is a colour wheel developed by Johannes Itten in the twentieth century. The colour wheel shows the relationships between primary, secondary and tertiary colours. Red, yellow and blue are the primary colours. They yield secondary colours, such as orange, green and purple when they mix. Tertiary colours are created when the primaries mix with the secondaries.

Figure 1.45 Johannes Itten's colour wheel shows the relationships between primary, secondary and tertiary colours.

ii) Value

Value is the lightness or darkness of a colour. As one can probably notice, the colours in Johannes Itten's colour wheel have noticeable lightness or darkness. Yellow is lighter and purple is the darkest colour.

Of course, this isn't a case of singularity. By adding white to produce a *tint* or black to produce a *shade* of a colour, it can be lightened or darkened. Since yellow is a lighter colour, it is able to produce more shades than tints. Blue, on the other hand, produces more tints because it is darker than the middle tone.

The value of a colour is also being affected by its context. The same colour appearing on a black or white background produces different visual values of it (Fig. 1.46).

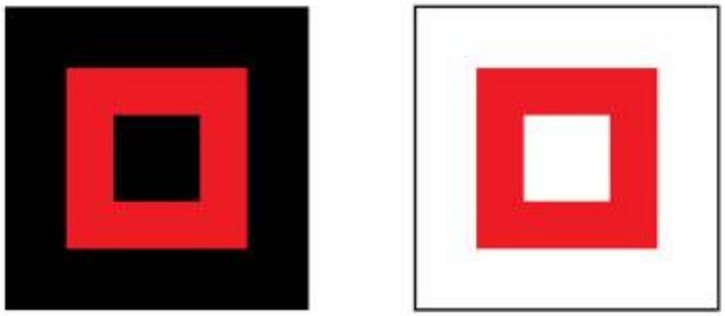


Figure 1.46 The red appears to have higher value, although the two reds are of the same colour.

iii) Saturation

Saturation is the intensity of a colour. A high-intensity colour is referred to as *bright* by the most people. Since the impurities, white and black are being filtered from a colour, the end result is a colour of high-intensity.

One can lower the intensity of a colour by adding its corresponding grey or its *complementary colour*. Depending on the grey added, it is possible to change the saturation without changing the value of the colour. Colours of lower intensity are called *tone* (Fig. 1.47).

Figure 1.47 Tones of yellow

The same trick is possible as in the case of putting a colour against a black or white background to change its visual value. The visual saturation of a colour can be enhanced by putting it against its complementary colour. This effect is called *simultaneous contrast* (Fig. 1.48), which most artists and designers use when they want to achieve a colour of higher brilliance.

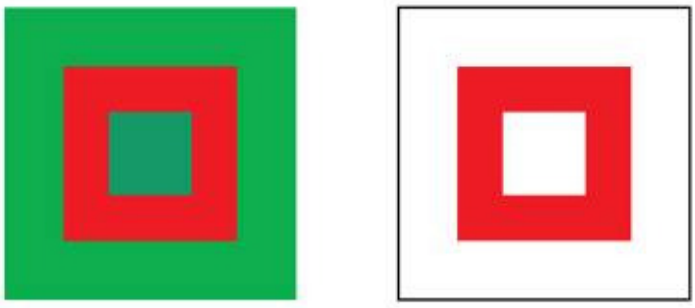


Figure 1.48 The complementary colours red and green added to each other's brilliance, making the red appears brighter than that on white background.

B. Colour phenomena

i) Colour temperature

The temperature of a colour can be measured by optical-electronic devices. However, the temperature here is more psychological than physical. It is the sensation of colour the viewers associate with their daily experience.

Red and orange are hot (fire), while yellow is warm (sun). These are called *warm colours* by many designers. Blue is cold (water) and green is cool (plant). They are referred to as *cool colours*. By looking at the colours, one can induce a sense of coldness or warmth within themselves.

Figure 1.49 Compare the colour temperature of the sea during the day time and sunset.

ii) Colour and space

Colours cause the muscles in our eyes contract or relax. When we look at bright or warm colours, the muscles tense up and give us an impression of 'objects in the foreground'. As a result, high-intensity and warm colours advance forward, while low-intensity and cool colours

retreat backward. Designers often use this phenomenon to create the illusion of space and depth, giving the viewers sense of movement or depth even on 2D works.

Figure 1.50 The architect's use of multi-colour exterior gives emphasis to the building as a foreground against the bluish sky, emphasizing the spatial relationship.

iii) Analogous colours

Analogous colours include several hues that are beside each other on the colour wheel. They may vary in value, but they create a sense of harmony. Disagreement between colours minimizes because analogous colours are neighbours and related to each other strongly.

iv) Complementary colours

Complementary colours are colours directly opposite to each other on the colour wheel. As discussed earlier in simultaneous contrast, complementary colours being placed side by side to each others heighten the brilliance of one another. A simple experiment illustrates how our eyes see colours: Stare your eyes on a colour for at least ten seconds. Then move your eyes onto a blank white area. You will see an after-image of the complementary colour. This actually explains why complementary colours become more brilliant when placed side by side (Fig. 1.51).

Figure 1.51 Pairs of complementary colours

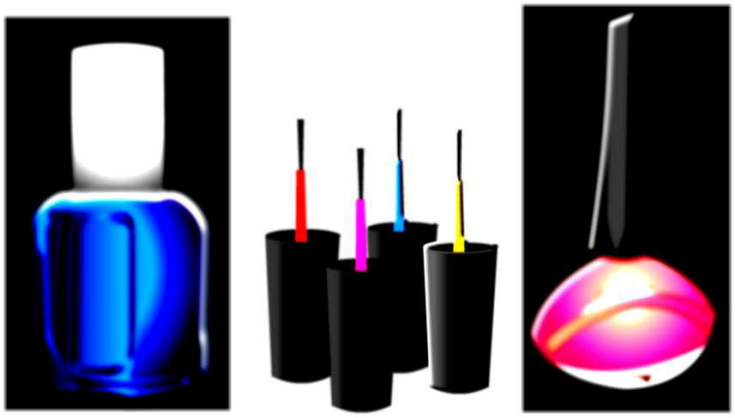
S T O P A N D T H I N K

How are colours used to convey message?

Colours are often used to communicate messages. Colours are very useful, particularly, in bringing an emotion across. The following show some examples of their use.

Analogous colour scheme. Claude Monet's Water-Lilies. The overall bluish green hue brings about a harmonious expression. Together with the subject of pond, reflections, flowers and leaves, the drawing expresses tranquillity.

Complementary colour scheme. The orange buttons and orange ring of rechargeable battery contrast with the dark blue fastener driver body.



Colour naming is an art in cosmetics. Consider these names and you will understand the very subtle change of colour and its effect. "Heat Wave", "Dark Pleasure", "Code Red" and "Tai O" and "Star Daisy".

Tints of green in an interior design scheme. Using tints of green as the dominant colour as well as and grey and brown as the accent colours promotes natural liveliness, vitality and youthfulness.

1.1.5 Space

A. Positive and negative space

There are 2D and 3D spaces in design. A blank space is known as *negative* and an object-filled space *positive*. The visual experiences of most audience are told, from primary education onwards, that they see areas that contain objects, images and colours. We look at images with people, buildings sceneries and artefacts; we read books with black text and printed images against a white background, but we seldom consider the space without any

objects. Intentional use of the negative space produces unexpected and often interesting results (Fig. 1.52, 1.53).

Figure 1.52 The work displays a careful thought about negative and positive spaces.

Figure 1.53 Another example of positive and negative spaces

B. Illusion of space

Creating illusion of space has always been a way to intrigue the eyes of the audience. As discussed in the section Colour and Space, the audience's vision is brought forward and backward by the change of hue, tone, tint or shade. In turn, it inflicts sensations of movement and depth. There are four different ways to create sense of space in design.

i) Perspective

In reality, a perspective occurs when a viewer sees things in the 3D world. All objects placed in a 3D world are bound inside a set of perspective views at the discretion of the viewer (Fig. 1.54). These perspective lines converge to a point (Fig. 1.55). They also define and enhance the quality of space and depth.

Figure 1.54 Convergence of the top and bottom lines of the buildings suggests depth and space

Varnishing Point

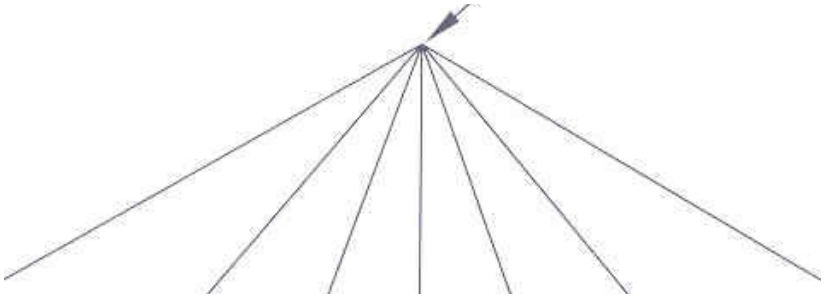


Figure 1.55 Perspective lines converge to a vanishing point at eye level.

ii) Overlapping

Overlapping objects or images create layers, increasing depth and volume of a space (Fig. 1.56, 1.57).

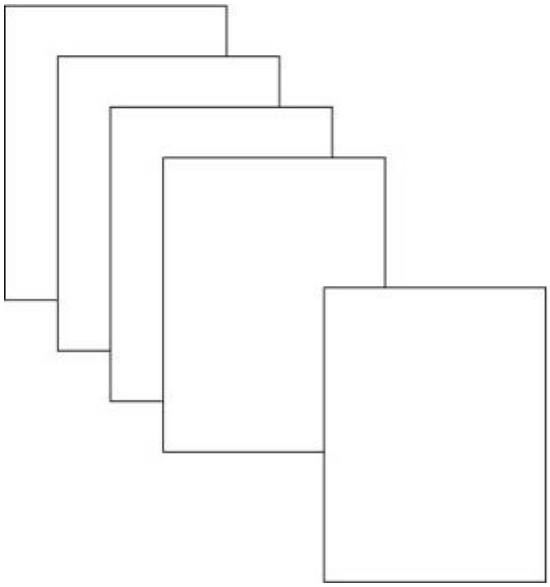


Figure 1.56 Overlapping objects or images create layers.

Figure 1.57 The wall of a local fast food restaurant uses overlapping glasses and backlit lighting effects to create depth and volume.

iii) Scale

We are aware that objects close to us are bigger in size while distant objects are smaller. It becomes a visual clue of space when the designer scales the elements in a design.

Figure 1.58 The difference in scales of human figures suggests 3D space

iv) Colour

High-intensity, darker and warm colours appear as foreground (refer to Topic 1.1.4 Colour). Low-intensity, lighter and cool colours, on the other hand, retreats to background.

S T O P A N D T H I N K

How are space and depth created in designs?

Frequently, designers adapt means discussed above to create illusion of space and depth in their design. How do they do it? You may find some reference in the examples below.

Look at the way depth is being created in this poster. By varying the sizes of the crystals and precious stones, the designer enriches foreground and background relationship.

On closer examination of Frank Gehry'sGuggenheim Museum, there is a rich layering of architectural structures.

A wedding gown verses casual dresses. There are more layers of laces and delicate overlapping of fabrics whereas there is much less layering in casual dress on the right pictures.

1.1.6 Texture

Visual and Tactile Texture

All materials, natural or man-made, carry a texture on their surfaces. Texture can be felt or seen. Roughness or smoothness is often used to depict texture. For instance, glazed ceramics, glass, polished metal and silk are often described as smooth. On the other hand, rock, most

tree skins and coarsely-grounded wood are often referred to as rough. In that sense, textures are created by the materials' visual or tactile quality. A texture that can be sensed through touch is called 'tactile texture'. Texture that is perceived only through the eyes is 'visual texture'.

Qualities, such as 'rough', 'smooth', 'dull', 'shiny', 'coarse' and 'sleek', are often used to describe a texture. In the absence of light, texture can only be sensed through touch. Light, therefore, contributes a lot when a texture is sensed through visual. The light factors, which include the direction of light, intensity of light and distance of light, decide how we perceive texture.

Designers create textures using various techniques and media. By doing so, the message carried with a designed object is often projected and reinforced. A rough, coarse or dull surface is often related with casualness, nature and wilderness. A smooth, shiny, glazed or sleek surface is connected with civilization, modernity and intelligence. Figures 1.59 to 1.64 show different materials used for similar objects. Interestingly, different materials express different messages.

Figure 1.59 Smooth glass carries a message of modernity.

Figure 1.60 Natural finish clay cups suggest nature and casualness.

Figure 1.61 A polished aluminium chair suggests civilization and modernity.

Figure 1.62 A leather seat projects a feeling of natural comfort.

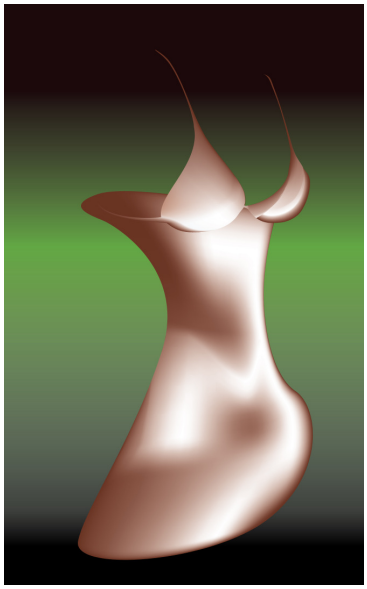


Figure 1.63 Using metallic materials on dress gives a meaning of intelligence and high society.

Figure 1.64 Denim dress gives feeling of raw and untamed.

1.2 DESIGN PROCESS

Design and technological development

Technological and scientific inventions depend very much on the availabilities of other inventions. For instance, the invention of a vacuum cleaner requires that of an electric-motor technology, filtering technology as well as electronic technology. This synergistic relationship occurred from the dawn of humankind, with the invention of the simple tools; and continues into modern technologies, such as the printing press, the Internet, mobile phone, aeronautic to space technology, etc. Technology and science, in a sense, is pushed forward by every little invention created here and there.

Therefore, technology and science is a *continuous development process*. Another example to demonstrate the idea of the continuous development process is the designs for communication. In ancient time, communication over great distant is possible by physically delivering the message to the receiver, be it horseback or walking. With the development of communication systems, the road, railway, car and train, the postal system emerged. The urge to communicate faster and boundary-free brought the telephone system. Then it was the telex and fax machines. Nowadays, mobile phones and the Internet become dominated communication media. Do we choose horseback as a communication medium in the 21st Century? The answer is certainly negative.

Design develops in a quite different path, nonetheless. Although it relies also on availabilities of technologies and materials, design is mainly about the synthesis of idea, technologies and materials. Consider chair design. The very first chair was designed for a person to sit. The function basically does not alter through the evolution of chair design. Modern chairs may have good variations of materials, ergonomics and other added-value components, but the function does not change. On closer examination, you will find that there are new materials like plastic, alloy, waterproof fabrics and so on; better ergonomic designs to fit different sitting situations; even added-value components like mechatronics in massaging chair. There are definite improvements in chair designs, but the function remains.

For that reason, design is a *spiral development process*. New technologies and science added to the quality of a design do not change the function. Nevertheless, the outlook of a design may change radically. Every successive design is in a way better than its predecessor. A spiral, thus, is a more precise description of the development process of design.

Design development process

Unlike art, design often begins at a specific need, goes through creative processes and ends at a pre-determined result (Fig. 1.65). In art, the development of the work is often based on the emotional instinct of the artist. Since there are no pre-defined conditions for the result, the final piece of work can sometimes be very experimental or even stray off from the original goal.

Design is very different in that perspective. First, there are specific needs to be fulfilled. Second, the design process is target-oriented that aspires to yield result for the specific needs. Third, the design process also takes product value, consumer behaviour, production cost, safety and environmental issue into consideration. In other words, the end users, economic value and environment are key factors in the design process. Finally, if the final result does not achieve the specific needs, the design process has to be re-iterated.

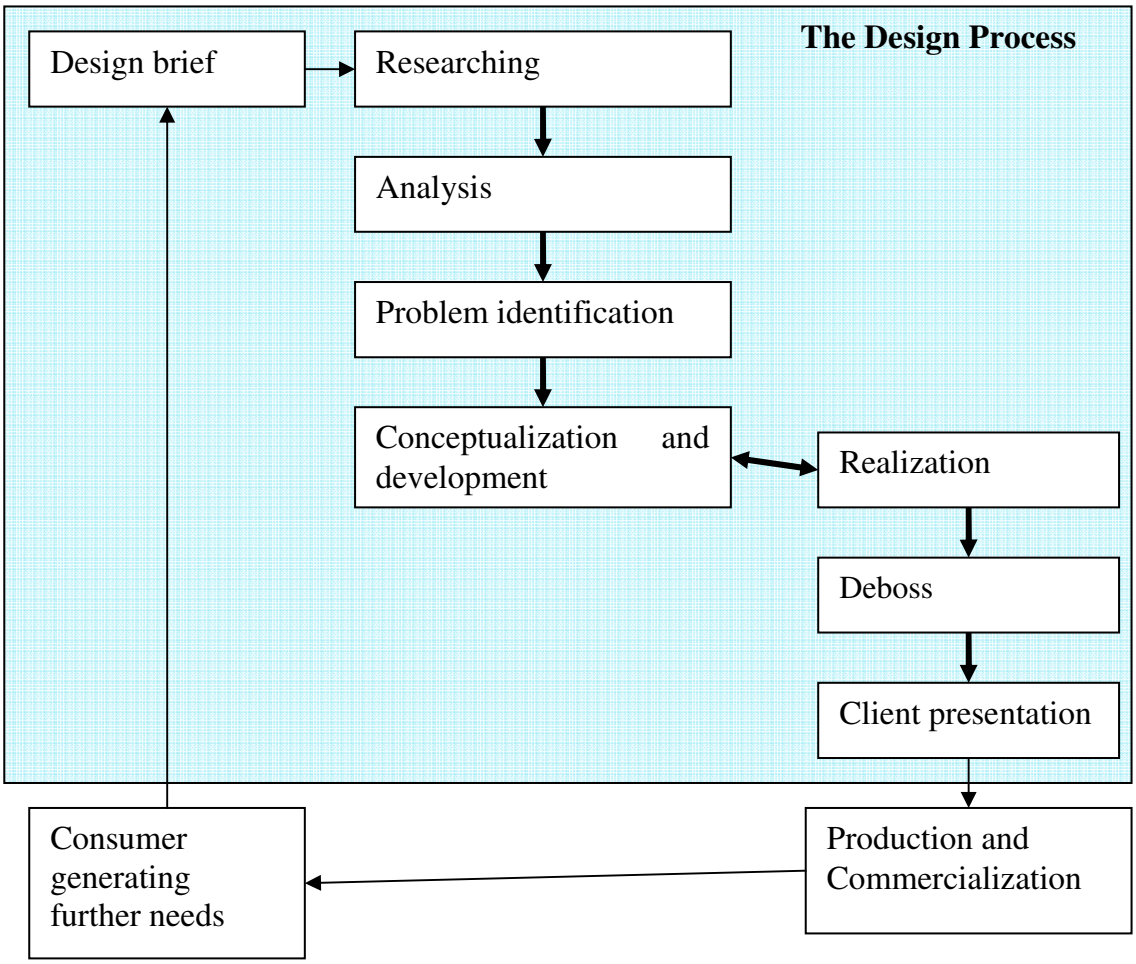
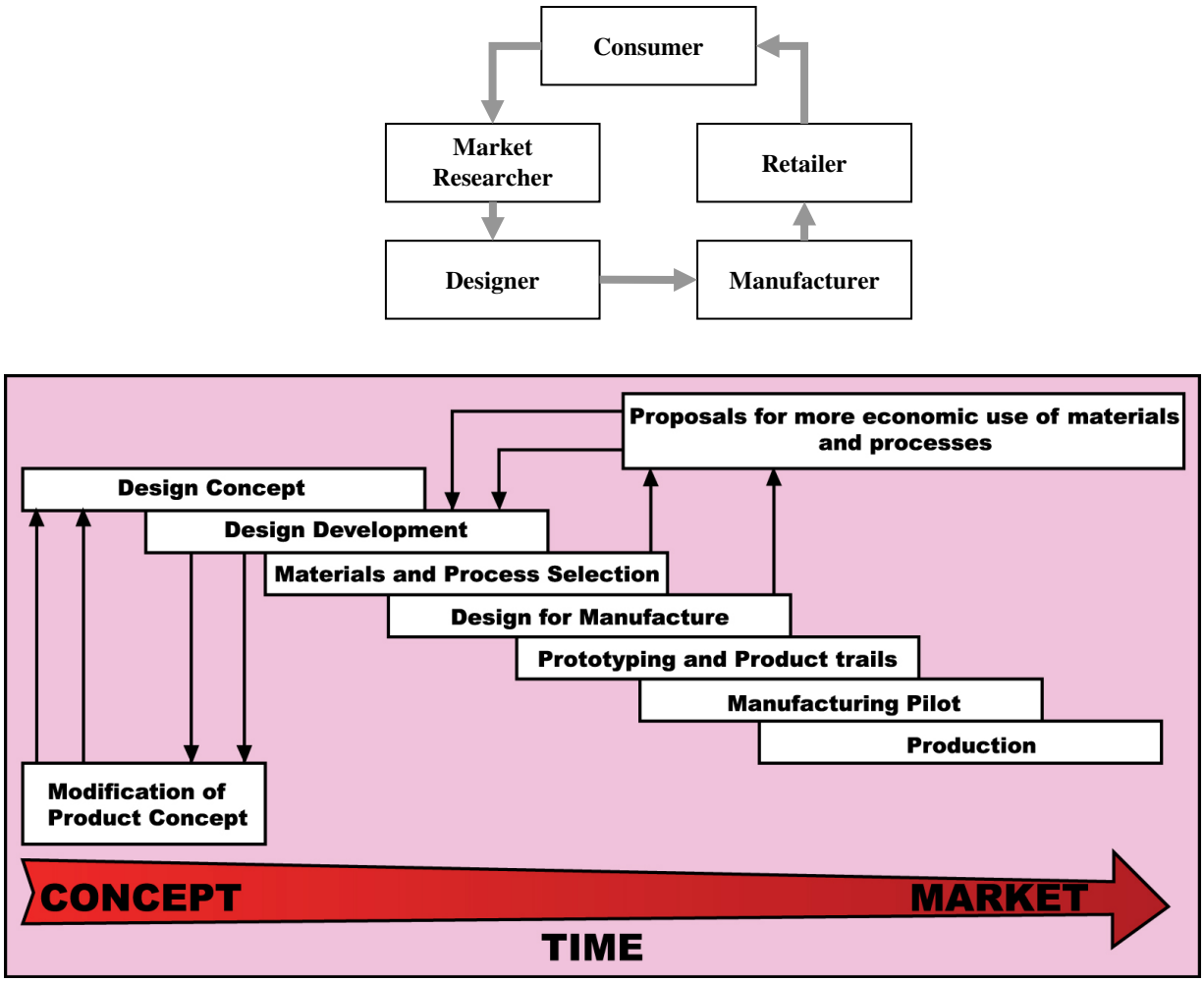


Figure 1.65 The design process is embodied in the blue box.

H I G H L I G H T

The Product Design Cycle

Market researchers are often employed to identify consumer needs and reactions to existing products. The collected information is utilized by the designers to develop new products, and update or modify existing ones.



Model of concurrent or simultaneous engineering

1.2.1 The design brief

This is a clear statement of the problem which the designer has to solve. The design brief must be short and complete. It must give all the information available about the problem. It must list all the things to be thought about. It is up to the designer to solve the problem, so the brief will not give an answer, but only information.

Where does a design brief come from? It originates from the needs of consumers, as listed below. Details will be discussed in Chapter 2 Design Considerations.

(a) Psychological need,
(b) Safety need,
(c) Love/Belonging/Social need,
(d) Esteem need,
(e) Cognitive need,
(f) Aesthetic need,
(g) Self-actualization, and
(h) Self-transcendence.

1.2.2 Research

Research methods

(a) Literature search – best for a fast capture of existing designs, market trends and user preferences. Comparison reports and product test reports often contain useful information on product designs and performance. It is an inexpensive yet convenient way to collect information. However, literatures are often printed and second-hand information. The information often comes in magazines, books, newspaper and journals. If the designer requires retrospective or existing information, this is a good source.

(b) Market survey – often carried out by experts in marketing business. It often selects specific groups of end users or products for comparison. Information is first hand, but collecting information this way is often expensive. Focus group discussion, interviewing, questionnaires, telephone interview, product testing and comparison often provide quantitative information for the designers. For instance, the TV commercials for Coke were often shown to teenagers to test its visuals, jingles and pace. The teenagers were asked to rate these qualities before the TV commercials were being brought on air.

多功能噴墨打印機資料比較

編號	牌子	型號	大約零售價	每分鐘打印文字頁數	打印一頁A4相片所需分鐘	耗電量(瓦特) 關機	耗電量(瓦特) 備用/省電模式	每年大約多錢電費	打印一頁A4墨水價錢 黑色文字	打印一頁A4墨水價錢 彩色圖表	打印一頁A4墨水價錢 彩色照片	估計每年墨水開支
1	佳神 Canson	PIXMA MP610 7890	$1,888	9.7	1.6	0.6	2.2	$10	$0.18	$0.8	$3	$280
2	愛普生 Epison	STYLUS PHOTO RX690 XX	$1,788	4.6	3.2	0.2	2.2	$7	$0.34	$1.5	$9	$667
3	愛普生 Epison	STYLUS PHOTO RX590 XX	$1,788	4.3	3.7	0.2	1.1	$4	$0.30	$1.8	$9	$688
4	佳神 Canson	PIXMA MP520 7890	$1,088	8.1	2.4	0.6	2.2	$10	$0.25	$1.0	$3	$316
5	惠普 HP	Photosmart C8180 7890	$3,288	6.0	3.7	4.9	7.8	$50	$0.66	$0.9	$8	$592
6	惠普 HP	Photosmart C6280 7890	$1,488	5.8	3.7	3.7	5.1	$36	$0.42	$1.0	$6	$461
7	佳神 Canson	PIXMA MX308 7890	$788	7.9	3.4	0.6	1.2	$7	$0.47	$1.3	$5	$460
8	愛普生 Epison	STYLUS CX9300F XX	$1,388	3.8	5.6	0.1	2.3	$7	$0.37	$1.5	$6	$499
9	惠普 HP	Photosmart C7280 7890	$2,688	4.9	3.7	4.4	5.8	$42	$0.47	$0.9	$7	$550
10	愛普生 Epison	STYLUS CX8300 7890	$1,088	3.9	5.5	0.2	2.2	$7	$0.39	$1.7	$6	$551
11	兄弟 HD	MFC-685CW 7890	$2,488	3.0	6.8	2.8	5.4	$31	$0.28	$1.0	$5	$398
12	兄弟 HD	MFC-465CN 7890	$1,788	3.0	5.5	2.6	4.7	$28	$0.27	$1.0	$5	$404
13	惠普 HP	Photosmart C5280 7890	$1,088	6.0	2.6	4.7	4.9	$41	$0.38	$1.5	$8	$642
14	惠普 HP	Photosmart C4280 7890	$888	6.4	8.7	7.3	7.3	$63	$0.35	$1.6	$10	$733
15	兄弟 HD	DCP-350C 7890	$880	3.0	6.4	1.7	3.7	$20	$0.28	$1.0	$5	$410
16	兄弟 HD	MFC-235C 7890	$980	2.9	9.2	2.6	4.7	$28	$0.30	$1.1	$5	$418
17	兄弟 HD	MFC-260C 7890	$1,288	2.9	11.8	2.9	4.4	$29	$0.32	$0.9	$4	$360
18	兄弟 HD	DCP-150C 7890	$680	2.9	13.4	2.3	3.6	$23	$0.32	$1.0	$5	$394
19	兄弟 HD	DCP-135C 7890	$588	2.9	6.4	2.4	3.7	$24	$0.26	$1.1	$5	$414
20	惠普 HP	Photosmart C4385 XX	$988	5.9	8.8	6.2	6.2	$53	$0.36	$2.1	$10	$803
21	利勤 Lexming	X4550 7890 XX	$1,150	7.5	5.0	1.5	10.5	$38	$0.39	$1.1	$14	$894
22	愛普生 Epison	STYLUS CX5500 7890	$588	2.6	15.4	0.1	3.2	$9	$0.36	$1.7	$7	$574

註

所列資料根據實驗室的量度及本會的調查與計算，可能與製造商發佈的有出入。

型號

[1] 測試樣本是STYLUS PHOTO RX685，製造商發佈設計及規格與本地版本RX690完全相同。

[2] 測試樣本是STYLUS PHOTO RX585，製造商發佈設計及規格與本地版本RX590完全相同。

[3] 測試樣本是STYLUS CX9400 Fax，製造商發佈設計及規格與本地版本CX9300F完全相同。

[4] 測試樣本是Photosmart C4380，本地版本的型號是Photosmart C4385。

大約零售價

根據本會於2月底調查所得，實際零售價按地區及店號而異；由於價格經常調整，購買前應向不同的零售商查詢及比較。

每年大約多錢電費

指非操作時白白浪費電力導致的電費損失，根據實驗室量度所得的備用(或省電模式)及關機狀態耗電量來計算，並假設每天操作0.5小時，備用7.5小時，關機16小時，座每度電(kWh)電費為$1.0。

打印一頁A4墨水價錢

所列價錢是約數，根據墨盒大約零售價及測試所得可列印頁數計算。由於不同零售商售賣墨盒的價格差異頗大，故實際列印每頁的耗材費用亦會有差異。

估計每年墨水開支

假設每星期打印3頁黑白文件，2頁彩色圖表及1頁相片計算，僅供參考。

Figure 1.66 A typical product comparison chart showing performances of different brand of printers.

Where to search for the information?

Nowadays the Internet is a rich resource, but the designer should focus more on other sources also. The following provide some ideas of the place to look for the necessary information:

(a) Literature search
  (i) Library
  (ii) Book store
  (iii) The Internet
(b) Market survey
  (i) Museum and gallery
  (ii) Exhibition
  (iii) Marketing consulting firm

What to look for?

The design brief has set certain requirements for the design. By means of a research, a designer can gain more information on the design required. The information includes:

(a) End user's preference (trend),
(b) End user's demography (gender, age, education, profession, marital status and income),
(c) Marketing (competitors, pricing, distribution channel and promotion), and
(d) Production and material (technology)

There are several ways for a designer to gather information if it is not provided by the clients. The designer can use tactics to help collect information for further design, such as conducting surveys and focus-group discussion; talking to the end users or commercial institutions; observing consumer behaviours; browsing through magazines, books and the Internet; and visiting shops, galleries and exhibitions. Sometimes, these tactics are just as important because the designer often gains first-hand and more often intuitive insights into the design problems. Further discussion can be found in Chapter 2 Design Considerations on researching.

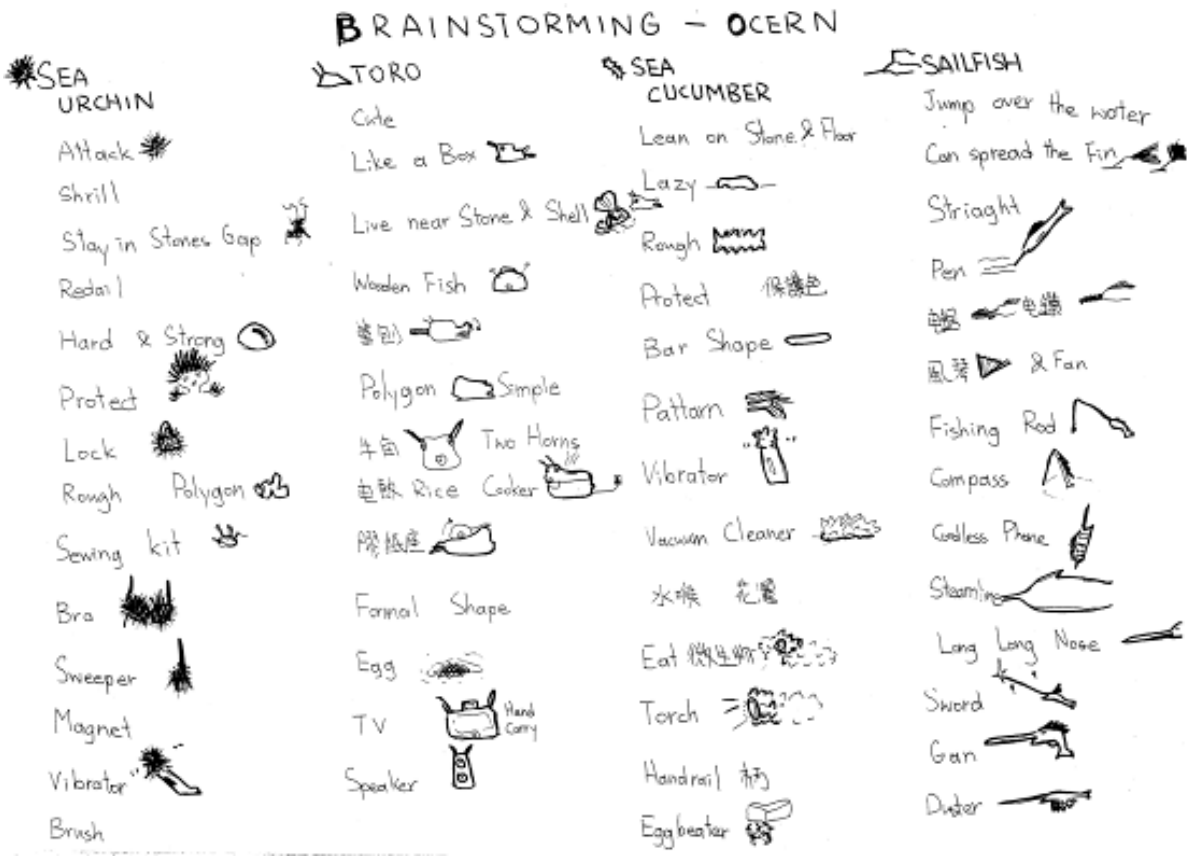
H I G H L I G H T

Documentation of the research

It is very important that a designer documents the information gathered. A folder is a convenient way to keep track of the information. Visuals as well as comments are elementary to a research. If these visuals cannot be captured photographically, sketches also work well. Another advantage of documenting the research is that the designer can review it or show it to a second person any time. The following are the researches done by a student on a project of

product design. The intention of the project was to capture the interesting parts of organisms on earth into a product. The student started by brainstorming different possibilities of organisms that interested him. Then, he studied the unique features of different living organisms in visual research. These were documented in either sketches or photographic images.

Brainstorming the possibilities



Research on different living organisms


LIVING THINGS RESEARCH - EARTH
FLY SQUIRREL
VENUS'S FLYTRAP
IVE ON REE
ALANCE
PIRAL
IGHORN SHEEP
MELLERS CHAMELEON
TATIC & EAN ON RANCH
REGARIOUS


LIVING THINGS RESEARCH - EARTH
FLY SQUIRREL
SHUNK
IGHORN SHEEP
CHAMELEOR
FLYSTRAP

1.2.3 Analysis and identifying the design problem

At some instances, the designer is presented with a lot of information for a design task. What does the designer exactly need may not be obvious in the first place. The client usually comes with some problems s/he faces. If the problem is succinct and requires no further investigation, the designer can begin the design task right away. Some clients may present the designer with a clueless problem. The designer must analyse the information in hand and decide the next step. Further discussion can be found in Chapter 2 Design Considerations on identifying design problem.

Succinct design problems

(a) Our major clients are teenagers, but this advertisement is not appealing to them, …
(b) There is a safety concern for this baby toy. It has too many small and detachable parts, …
(c) This packaging is consuming too much paper in the production, and causes environmental problems. We need to slim down the package …
(d) The restaurant is meant for the middle-class who understands French cuisine and winery, the interior design must be able to identify with them …

Clueless design problems

(a) Sales of this series of T-shirt is going down, we need to revamp the design …
(b) The mobile phone design seems to be disliked by the target users …
(c) The logo design is not good. The clients do not like it …
(d) People feel uneasy sitting in this restaurant. It needs redesigning …

S T O P A N D T H I N K

Identifying a design problem

'The end users do not like our mobile phone!'

The following is a simulation on how a designer can find out why the end users do not like a mobile phone design.

The mobile phone design seems to be disliked by the end users

Asking questions and observing consumer behaviours:

- *Do they think it's too big?*
- *Do they find the keys inconvenient?*
- *Is the surface easily scratched?*
- *Is the display big enough?*
- *Do they like the outlook of the mobile phone?*

Information and visual research:

- *What qualities do similar mobile phones possess?*
- *What are the lifestyles of the target users? Does this mobile phone fit their lifestyles?*
- *What special features do similar mobile phones have?*

Finding:
They think the mobile phone is too big for a female teenager and feel rather reluctant to show it to their friends.

Finding:
Most of the users are female teenagers who like to linger around with friends and exchange information on trends of fashion, pop singers and electronic products

Analysis
The mobile phone design is too big and the outlook is not trendy enough for female teenagers who often go out with friends.

Design problem
To design a mobile phone that is small enough for a female teenager's hand and which has a trendy outlook that provides a talking point for peers.

1.2.4 Conceptualization

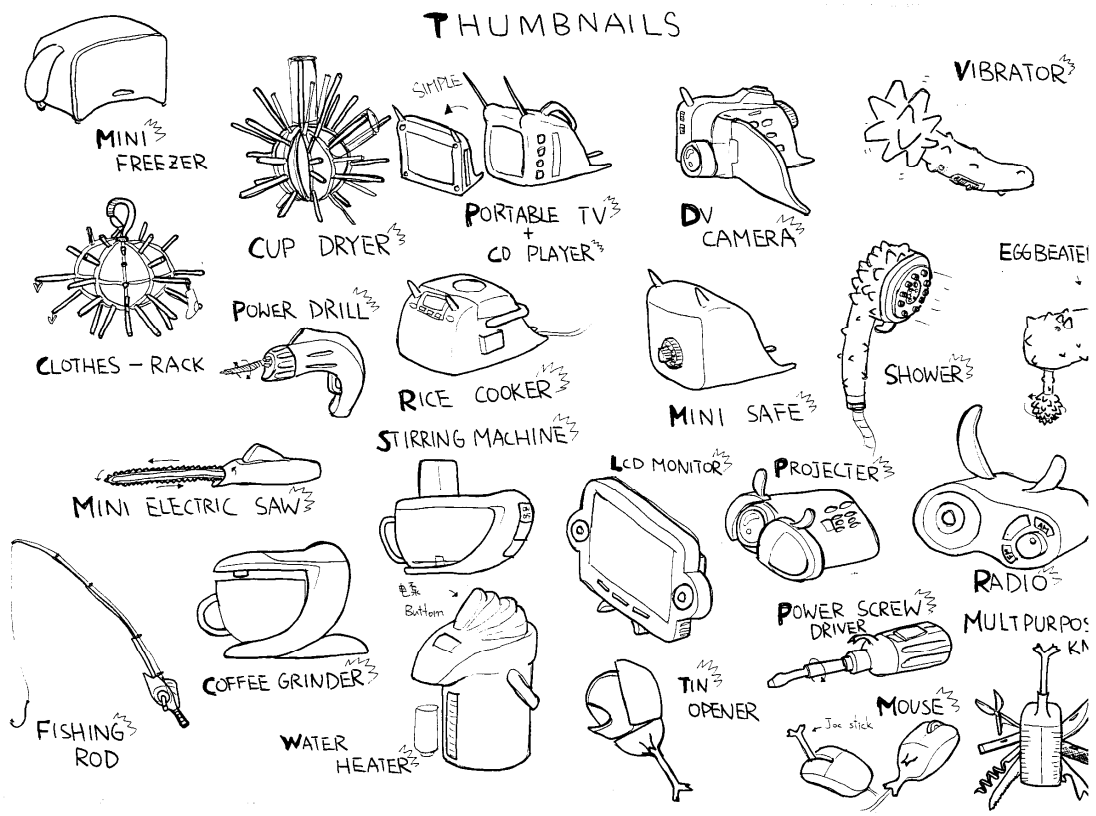
To conceptualize a design is to think of the possible solutions to a given design problem. There are thinking methods to help us through this process and they will be discussed in detail in later chapters. Concepts appear on 2D and 3D representations, again, will be discussed in greater detail in Chapter 3 Design and Communication. However, a designer must note that simply thinking without putting down the concepts on any forms will cause many misunderstandings. It is vital, therefore, that a designer must draw sketches or make models to represent her/ his concepts to the clients.

H I G H L I G H T

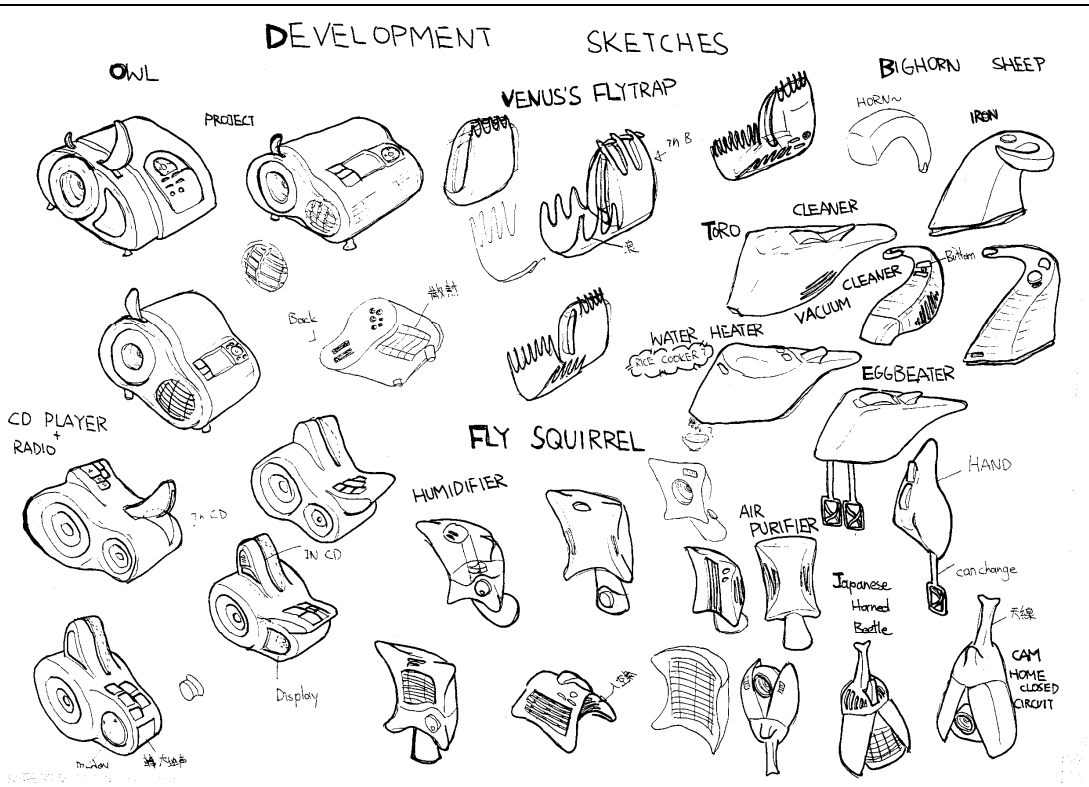
Conceptualizing a design

Continuing from the previous examples of research documentation, the student began the initial concepts. The following exemplifies the important stages of the projects.

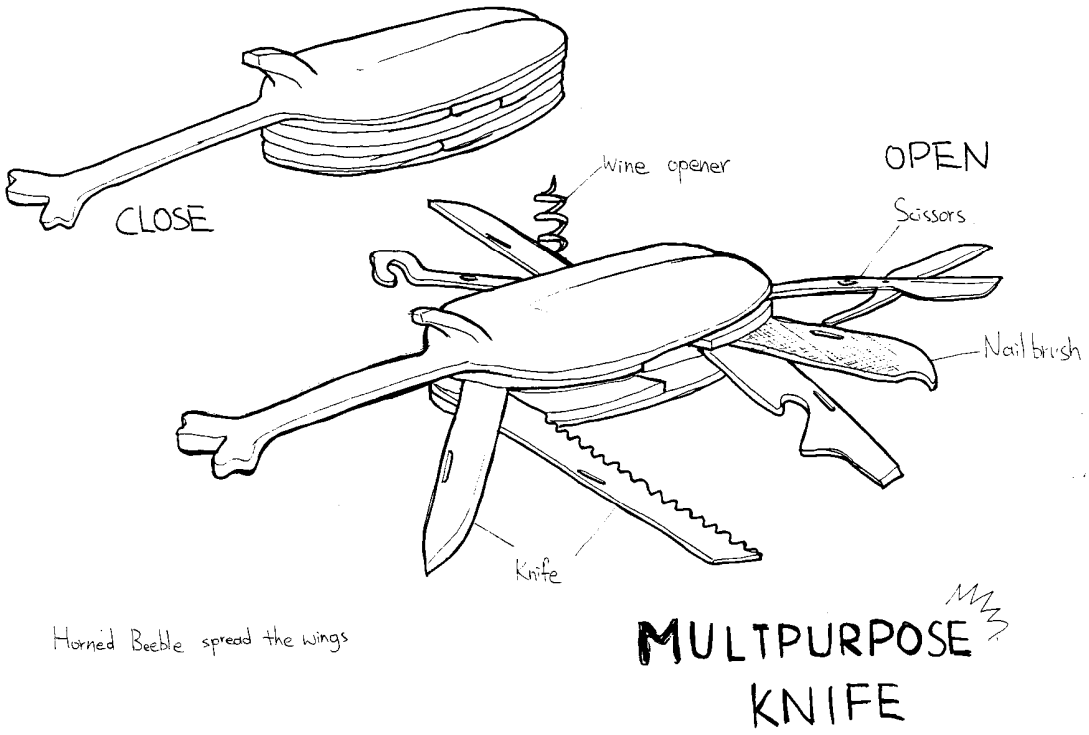
Initial concepts of combining the living organism and the product



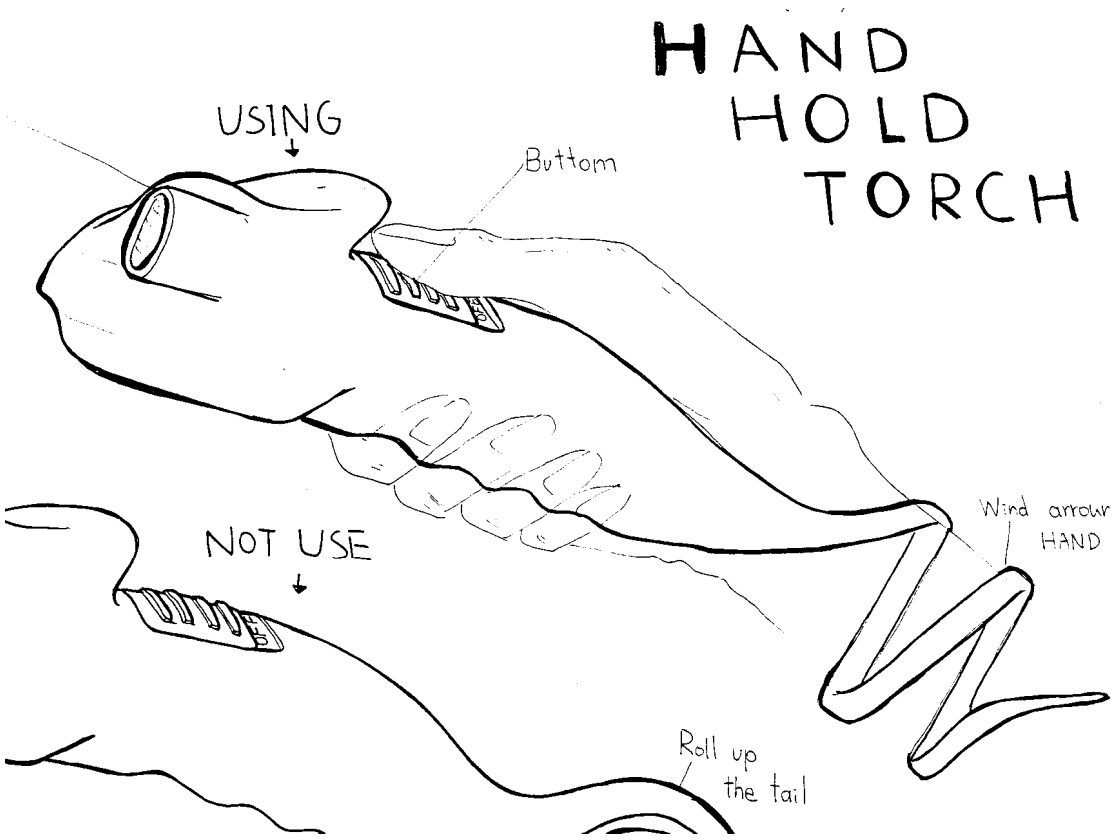
The student began doing thumbnail sketches on different possibilities of combining the living organism and the product. The student was free to use different products and living organisms at that stage.



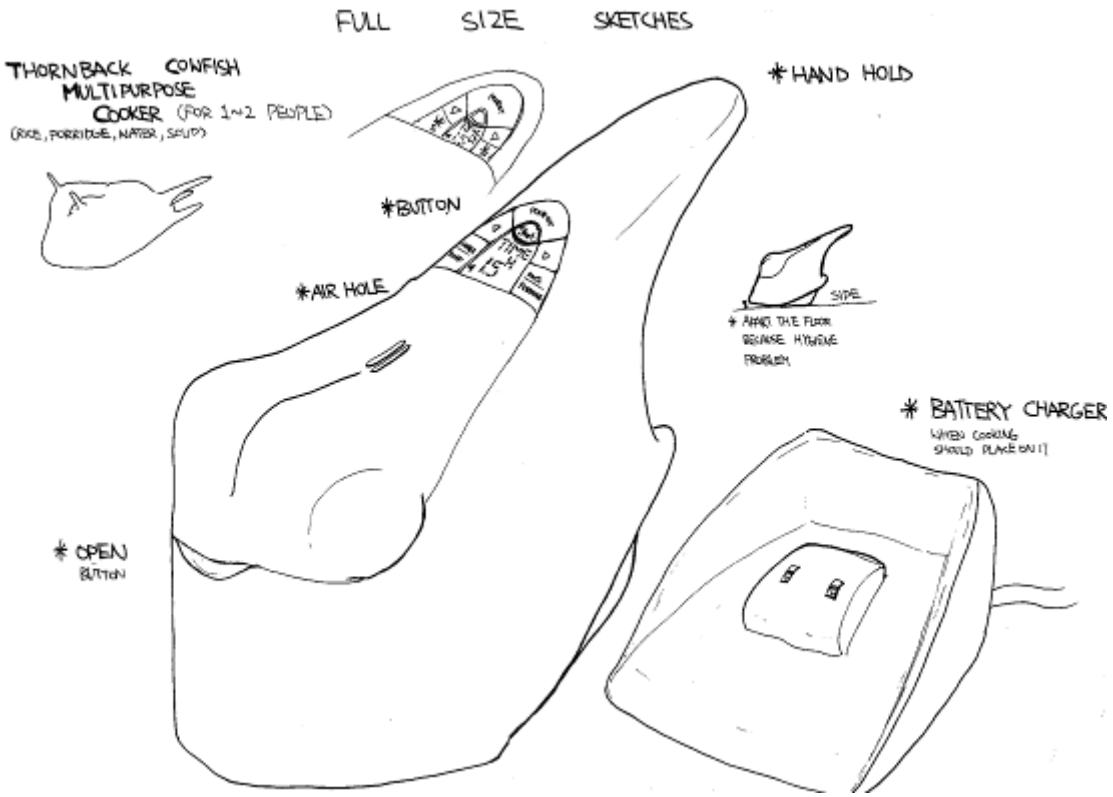
After several rounds of initial concept sketches, the students decided on several possibilities, including a projector, vacuum cleaner, dehumidifier, egg beater, CD player and flytrap.



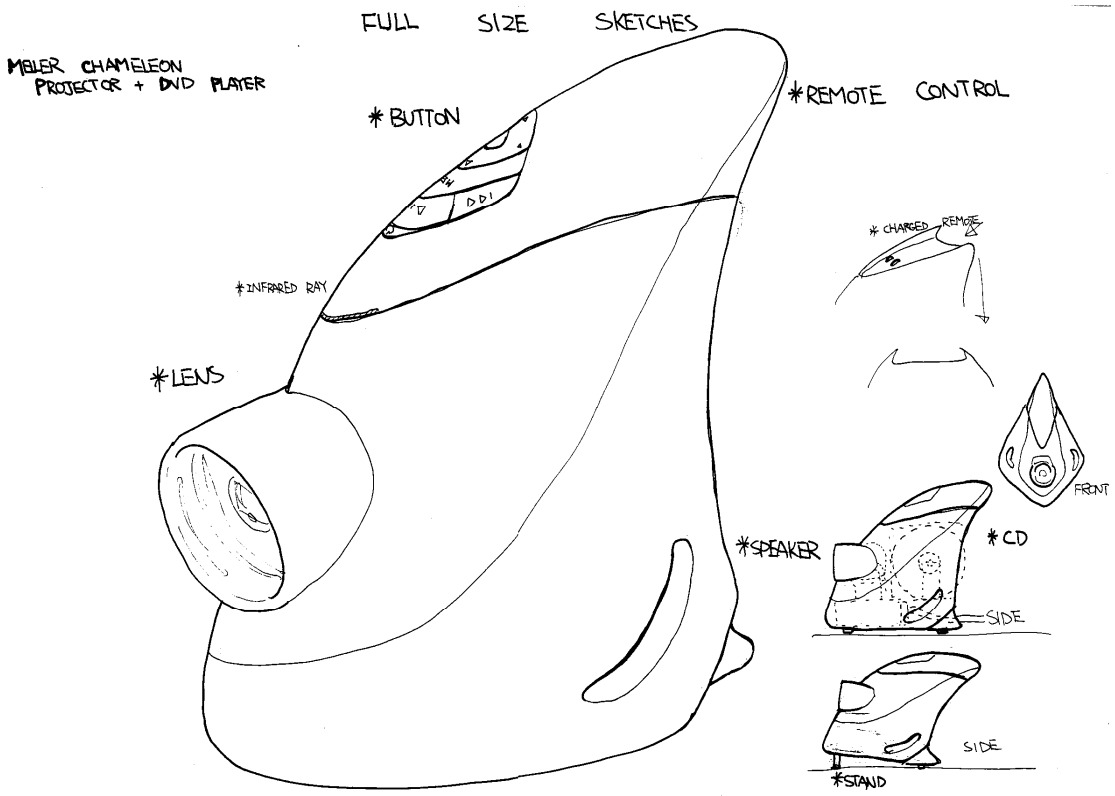
Focusing on several concepts was interesting. The student created larger sketches on the product design with finer details. The sketch was a beetle-shape multipurpose knife.



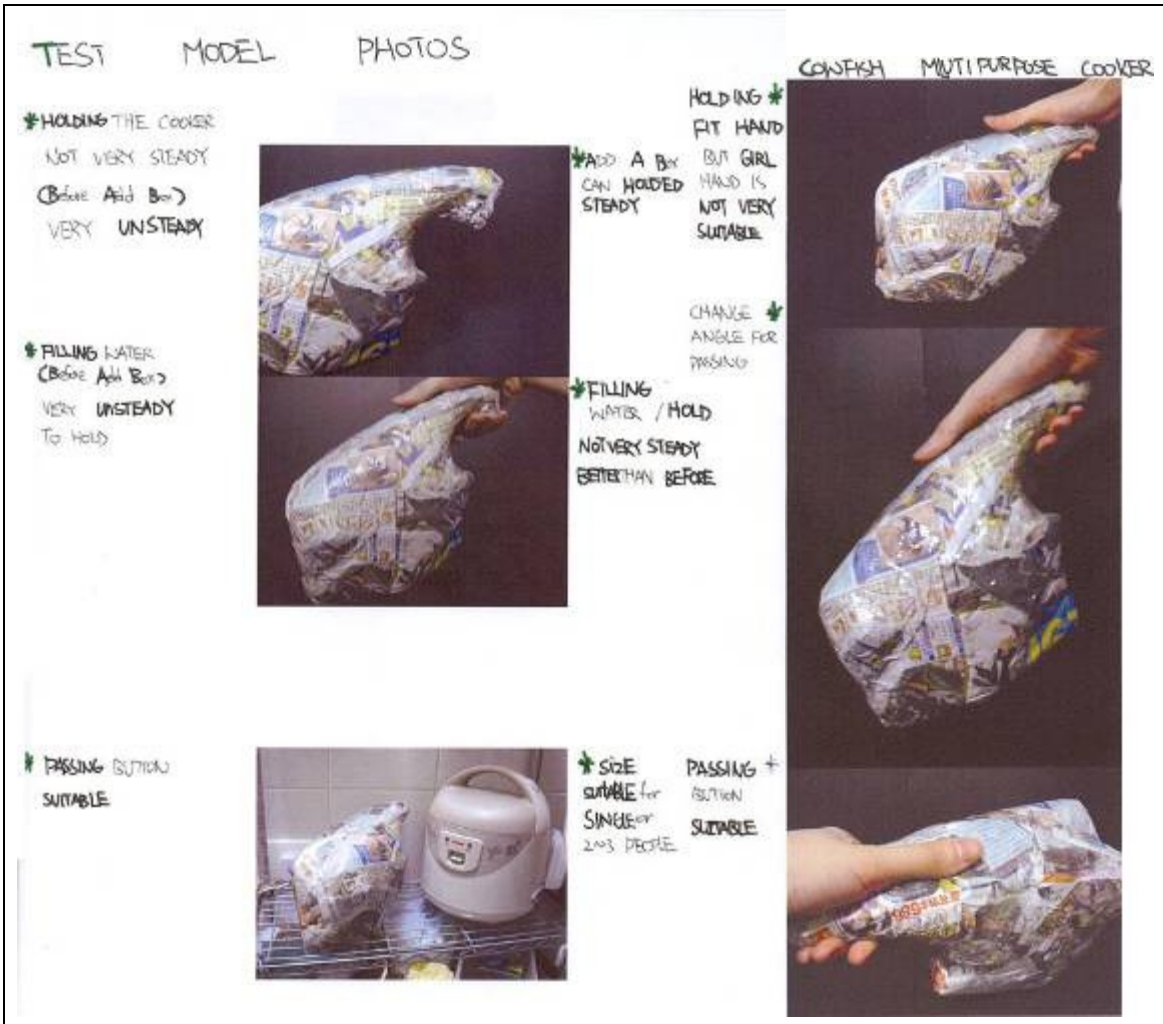
Another possibility of a lizard torch.



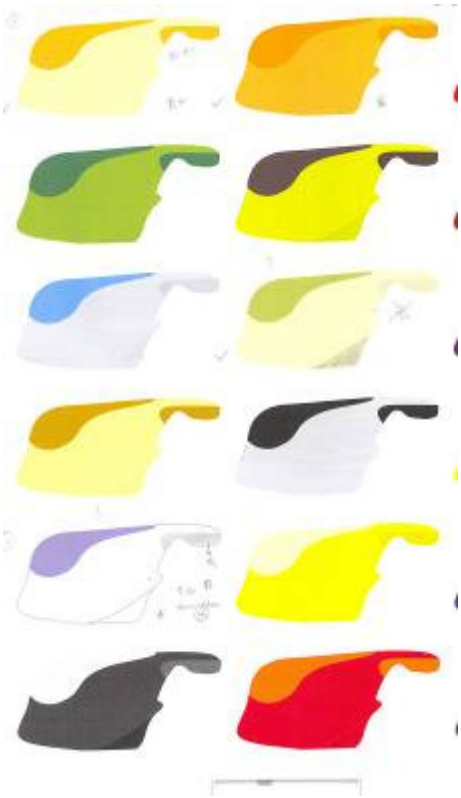
A cowfish multipurpose cooker.

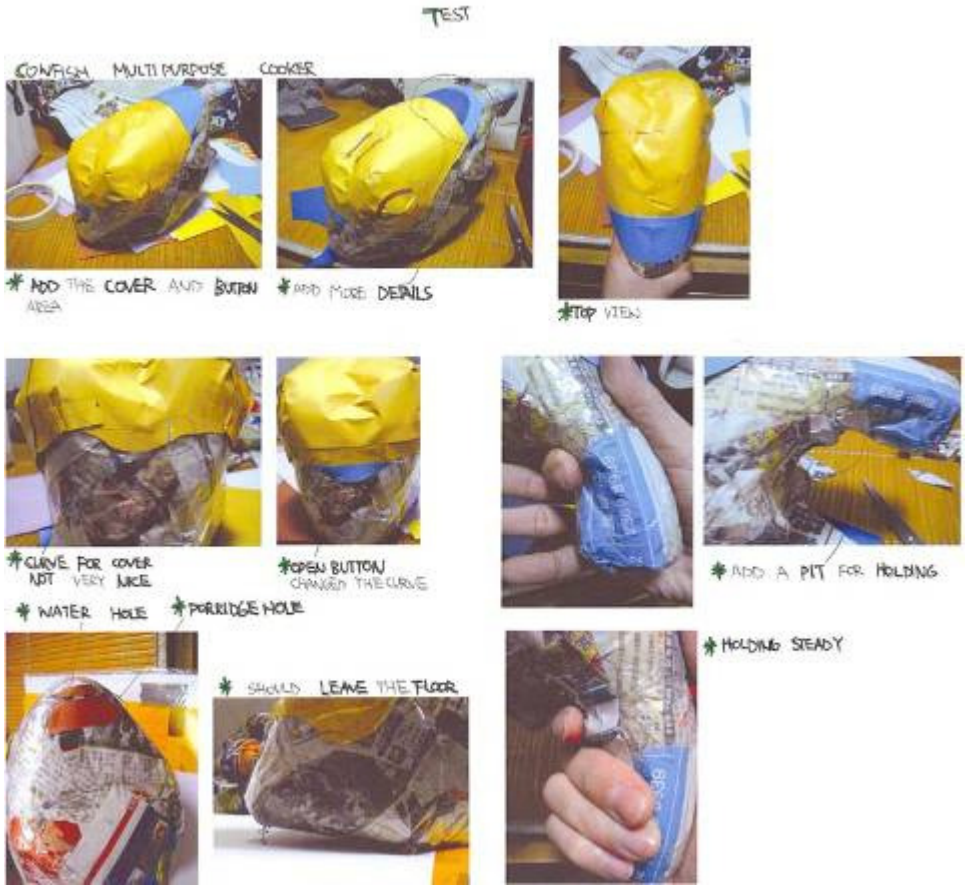


A chameleon DVD player and projector.



The student decided on the cowfish multipurpose cooker and did a quick newspaper mock up model.





Afterward, he wanted to test the colour and ergonomics of the buttons.


Foam model testing.








Details of button, indicator and embossed area being done on the study model.

1.2.5 Realization

A design process often requires back-and-forth communication between a designer and her/ his client. The designer creates a design and shows it to the client; the client gives feedbacks and the designer makes adjustments here and there. The process approaches its end when both the designer and client are satisfied with the design. A prototype will then be made.

What realization refers to is the final layout or model calling off the conceptualization process before the design is being produced on the assembly line. Chapter 3 Design and Communication will deal with the process of realization in greater depth.

S T O P A N D T H I N K

Realizing a design

Which medium is the best?

The medium used to realize a design can be varying depending on the following criteria:

(a) Time,
(b) Budget,
(c) Scale of the project,
(d) Requirement of the client,
(e) Competence of the designer, and
(f) Availability of technology and material

Student works-prototypes of a children's alphabet play set and tableware. Note the level to which they have been finished.

Student work-self adhesive film as a representation medium of pattern design on a table.

1.2.6 Evaluation

Evaluating a design is a crucial process before the design goes into commercial production. Apart from financial implication, the design has to be measured against the requirements of the design brief. The evaluation should aim for constructive criticism and suggestions for future improvements. Details on design evaluation can be found in Chapter 2 Design Considerations.

The designer should always ask if the following are fulfilled:

(a) Financial implication (Does the product generate income?),
(b) Specific needs of the users (Functionality, aesthetics, esteem, etc.),
(c) Effectiveness of the design (Does the design communicate well? Do the users understand the design?), and
(d) Safety and standard

Function
What is the purpose of the product?
What does it have to do?
Is the product fit for the purpose it was designed for?

Market
Who is the customer?
Who is the user?
What are the user's needs likely to be?

Ergonomics
Where is the product used?
Is it comfortable to use?

Aesthetics
Is the product pleasing to look at?
Is it well finished?

Materials and Manufacture
Have the most suitable materials been used?
How has it been manufactured?
Which production process was used: one-off, batch, or mass production?

Product life span
How long does the product expected to last?

Quality
Could the quality of the design or the quality of the manufacture be improved?

Safety
Is the product safe to use?
Are there any sharp edges or loose parts?
Does the material or the manufacturing processes harm the environment??

Costs
How does the cost compare with similar products?

Figure 1.67 Product evaluation criteria

1.3 CREATIVITY IN DESIGN

Humans design because they are discontented with the prevailing conditions they face. *Constructive discontent* is an attitude in creative activity. It yields the necessary motives to improve conditions with better designs.

Constructive discontent is necessary for a creative problem solver. If you are happy with everything the way it is, you won't want to change anything. Only if you become discontent with something, when you see a problem, you will want to solve the problem and improve the situation. A successful designer will constantly search for areas for improvement while enjoying the challenges that are being put up to.

There are various design methods and design thinking techniques that bring about a truly creative design. For most of the time, design solutions are open-ended. This is to say there is no fixed end or destination in design that solves a problem. For instance, if you want to open a can of food, you may use a can opener, an axe, a saw, a drill or design a pull-up lid as in most of the canned food packages.

Therefore, the creativity of the final design depends a lot on the creative tools that are available to the designer.

Change of a design

Design is evolving. Every designed object is an evolution of its previous form or function. Therefore, the design process complements the inadequacy in precedent design. The process improves design.

Reasons that initiate the change of a design include

(a) Change in culture
(b) Improvement in technology
(c) Availability of new materials
(d) Genesis of new social needs.

Imagine the design of a cup. There are changes in culture. For example, the fast food culture brought about paper cups and polystyrene cups. New materials, for instance, constantly change the cup design – ceramic, plastic, polystyrene, polycarbonate, aluminium, recycle paper, etc. Vacuum forming, press moulding, injection moulding, etc also change the way a cup is designed. Last but not least, the genesis of new social needs, such as the need for environmental conservation, also brings about the design of a cup. Therefore, the development of a design often refers to as a spiral cycle. It develops from the last design while improving on it.

Figure 1.68 Plastic cup that can only hold cold drinks.

Figure 1.69 Styrofoam cup, it can hold hot liquid.

Vertical and lateral thinking

In terms of thinking pattern, there are many styles. These styles can be categorized into *vertical* and *lateral* thinking.

Vertical thinking is a logical process through which a problem is deducted step by step until the final goal is achieved. It selects the best possible solution for further development while other solutions are discarded. There is also a sequence in developing a solution.

Lateral thinking is about generating probabilities. It is not about logic or sequence. Steps can be jumped and the notion of getting every step correct is not essential.

S T O P A N D T H I N K

Vertical and lateral thinking

Dinner for a family

A housewife wants a dinner made for her family. The first logical step will be deciding what to buy. Next, she goes to the market and buys the necessary food. Then, she goes back home for the cooking. The final step is the serving of food.

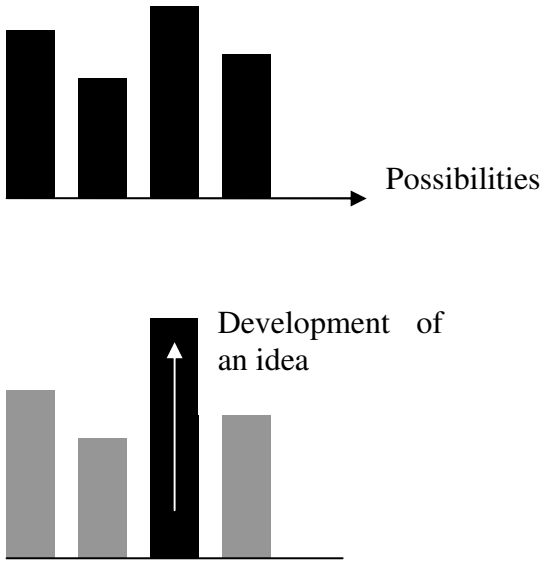
What if these steps are skipped, reshuffled or reversed? Can she still serve the family food? We probably imagine yes. Can she order take-away or delivery? Can she bring her family to visit a friend and stay there for dinner? Can she teach her son to cook so that he does the cooking in turn? Can she hire a temporary cook? Can she do microwave food instead? These probabilities, fundamentally, do not kill the serving of a dinner.

H I G H L I G H T

Vertical and lateral thinking

Using their strength at different stages

At a glance, vertical and lateral thinking are quite different in nature. The two thinking styles complement each other at different time of the idea generation and development process. At the beginning of the design process when ideas are needed in quantity, a designer needs lateral thinking. However, at later stages, especially the production stage, the thinking process often requires more verticality. Being able to shuffle between different thinking styles is essentially important.



Difference between vertical and lateral thinking method

1.3.1 Vertical thinking

A. The morphological chart

Morphological chart (Fig. 1.70) provides a well-structured approach to concept generation. The advantage is that it widens the possibility for creating solutions to a defined design problem. It helps the design team to generate an encompassing set of alternative design solutions by analysing different qualities of a product systematically, i.e., the form, configuration or functionality.

The morphological chart offers a visual way to display the form, configuration or functionality of a required product, and explores different ways and their combinations to achieve that functionality. The designer expresses as many possibilities as he can for each

quality of the product. Then the designer considers different alternative combinations offered by the chart. This helps to provide a very different approach for visualizing a design of a product and enhancing product concept development.

The method is simple and involves three main steps which are given below.

Step 1

List product functionalities or features which are necessary.

The list should include only main product functions. For example, a vacuum cleaner doesn't require the functionality of playing music. Ideally, the list should contain less than 10 items. The functions should be listed in order of importance, starting from the most important one. Each function listed should be different from and independent of the others.

Step 2

List all possible solutions that are able to achieve the functions listed.

The ideas can be expressed graphically or written words. All ideas no matter whether they are new or known should be included. The designer should note all important characteristics of each solution.

Step 3

Draw up a morphological chart containing all possible sub-solutions.

The chart will include the total solution for the product. It also provides the designer with the solutions derived from various sub-solutions. There should be a wide range of combinations as one can perceive. The designer should take out the least possible solutions and pick the ones that are feasible and producible. It is also a good practice to name the solutions so that it can be easily retrieved and evaluated later.

As the chart below shows, the designer can choose from these possible solutions to form a new design. The advantage of a morphological chart is that all the possibilities are laid out for the designer's consideration.

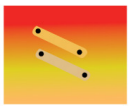
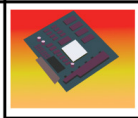
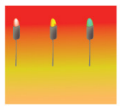
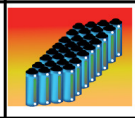
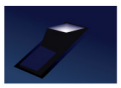
Pressure Sensing	Hardware Layout	Sitting Device	Interface between sensing and transmitting	Transmission to the Computer	User Interface	Initialization (Start up)	System Test	System Power
								
								
								
								

Figure 1.70 A morphological chart being drawn up for a chair design. Note that all the design requirements are listed on the top row with their possible solutions listed along each column.

B. Logical deduction

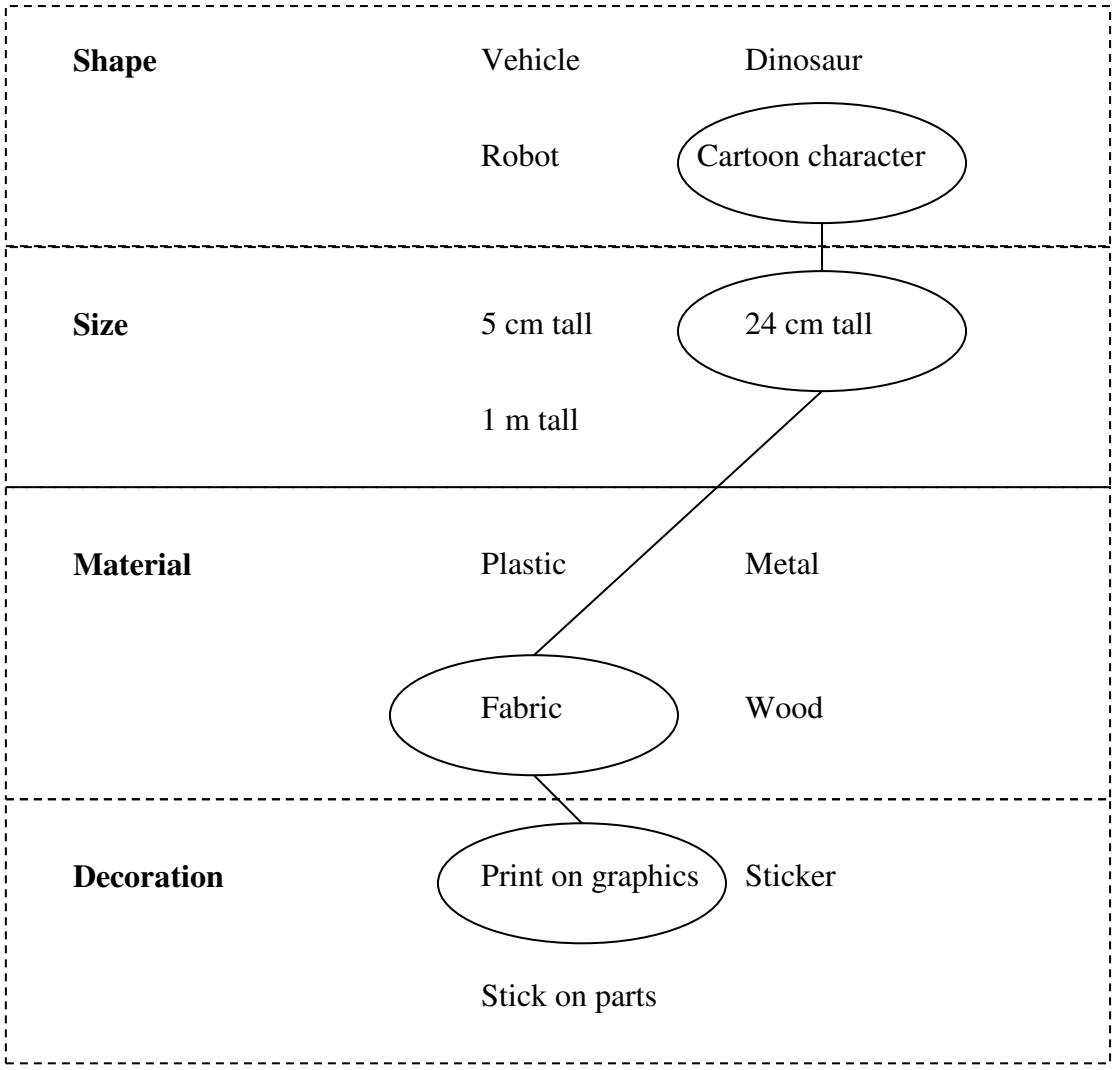
Logical deduction is a classic example of vertical thinking. It eliminates impossible solutions while retaining those most practical and highly possible. As a result, a design can be created in the most achievable way.

S T O P A N D T H I N K

Logical deduction

Designing a play doll for 3 year old kids

Let's see how a design for a play doll is yielded with logical deduction:



The solution is circled according to the criteria matched against a 3-year-old kid. Kids of this age probably don't understand robot, dinosaur or vehicle. Cartoon characters are more unisexual and provide better attraction for the end users. The doll's size cannot be too small because of the hazard of swallowing by kids. Neither can the doll be too big because a 3-year-old possibly cannot hold it.

The major material should be fabric so that the toy is texturally nice to kids. The decoration on it needs to be print-on graphics because it stays firmer on the surface while costing not too much.

You can see that the eliminations of possibilities throughout the process will finally leads the design to an expectable solution.

Advantages of designing with logical deduction:

(a) Reduced loss,
(b) Reduced murkiness in the design process,

(c) Effective time management,
(d) Higher success factor, and
(e) Higher control of the design process

Disadvantages of designing with logical deduction:

(a) Reduced possibilities, and
(b) Highly expectable outcome

C. Design by insight

Designing by insight is a strategy employed by most designers. The previous part discussed a design process. With thorough research, a designer can identify problems for initiating a design process. An adept designer, on the other hand, will study the research with great care, taking note of every possibility for analysis and problem identification.

Most research and analyses can help designers to decide on the design problem. Deep insights can be developed when a designer studies deep into a problem. It is especially true for complex products like a car in which a lot of issues are brought into consideration.

S T O P A N D T H I N K

Design by insight

Case of car design

Car design calls for the expertise of a range of designers with very different knowledge sets, such as aerodynamics, ergonomics, engineering, electronics, energy, safety, manufacturing, style and material. Production of a car cannot begin until problems of all these topics are solved: it usually takes years. Insight of the designer is very important. For instance, in testing out the aerodynamic efficiency of a car, the model has to be placed inside a wind chamber to find out flaws in the design. Re-working and re-testing of individual parts are required consequently.

The design areas include chassis design, engine design, cockpit design, style design, etc.

The design team gradually gains sufficient insights to produce a design that is acceptable both in aerodynamics and style. If you look at other designs required for the car, you will understand that designing a car does not happen only with inspiration. It takes a lot of insights through research, analysis and testing before the design unveils
Reference: http://www.cardesignonline.com/

1.3.2 Lateral thinking

Edward De Bono[1] developed lateral thinking to enhance creativity in problem solving. It is characterized by the shifting of thinking patterns away from conforming or predictable thinking to new or unexpected ideas.

For example, if we want to send someone far away a text message, the predictable thinking will be to send a letter by post or an email.

However, other possibilities exist:

(a) Using Morse Code (if the person has proper receiving device);
(b) Writing a letter, which will be put in a floating glass bottle (though it may never reach the person);
(c) Writing a letter, which will be tied to a pigeon (well the pigeon must know the way to find that person); and
(d) Buying an article space in a newspaper that the person reads.

Edward De Bono identifies four critical factors associated with lateral thinking, namely

(a) Recognize the main ideas that dominate perception of a problem;
(b) Search for different ways of looking at things;
(c) Relax the rigid control of thinking; and
(d) Use chance to encourage other ideas.

The last factor has to do with the fact that lateral thinking involves low-probability ideas which are unlikely to occur in the normal course of events.

A. Brainstorming

Brainstorming is a way to create innovative ideas without the constraints of logics. It can be done individually or in a group. The designer writes down or draws the concepts that come to his mind in a very free manner. It is a very good way to solve problems especially during the initial concept development stage of a design process. Brainstorming can be extremely speedy in generating broad ideas and developing a concept further. During the brainstorming session, the following should be observed:

1. No ideas should be criticized. Criticism will bring intimidation to individuals who participate in the brainstorming session.
2. The flow of ideas is important. When a brainstorming session comes to a standstill, it

[1] Edward De Bono has written many books on creative thinking and taught thinking as a mental skill. Teaching of his creative thinking methods is internationally patented and trainers of such courses must be a Certified Trainer authorized by the de Bono Education Ltd.

will be more appropriate to adjourn and resume later.

3. The atmosphere should be free, encouraging and cozy. If a participant is being bossy, he will discourage other participants to speak.

Individual Brainstorming

The designer is free from the pressure in a group brainstorming session and produces ideas independently. The method tends to generate more innovative ideas, but it is developed less effectively since no other people are involved.

Group Brainstorming

A group of designers or people participate in the brainstorming session. It is a very effective way to generate ideas because a participant can pick up the ideas of the previous participant and expand on them easily. Therefore, group brainstorming tends to produce more in-depth ideas than individual brainstorming.

Before a brainstorming session begins, the following should be observed:

1. The problem should be clearly defined.
2. The problem should be the focus all the time. Sometimes, brainstorming will drift the participants too far away and the brainstorming session will lose focus.
3. No evaluation and criticism of ideas should occur.
4. Encourage creativity.
5. Encourage participants to follow up on others' ideas in a group brainstorming session.
6. Try to get all participants to involve in a group brainstorming session.
7. Avoid dragging ideas along if the brainstorming session seems exhausting.
8. All ideas, whether written or drawn, should be kept track of.

B. Mind map

Mind map[2] helps you quickly in comprehending the structure of a subject by laying out all facts, raw data and relative information. Designers often use the technique to identify problems and possibilities. It is a very effective tool for the designer, in a way, because it is simple, memorable and can often be re-examined. A typical mind map (Figure 1.71) lays the relative information of a subject in a radial format. For most of the time, words and phrases are used to expand on a subject.

Problem solvers can often find hints when they review the 'map' of information because all information is laid out in an easily referable two dimensional format. Comparing to the conventional note taking in list format, mind maps enables associations easily. More

[2] Mind map is a trademark of the Buzan Corporation

importantly, information can be added on at a later stage without much interruption to the original.

Mind map are also useful for:

(a) Summarizing information;
(b) Consolidating information from different research sources;
(c) Thinking through complex problems; and
(d) Presenting information in a format that shows the overall structure of your subject.

They are very quick to review as you can often refresh information in your mind just by glancing at one and they are easier to be remembered and assimilated.

The following suggestions may help increase their effectiveness:

(a) Use single words or simple phrases for information, excessive words clutter the mind map.
(b) Write and draw neatly. Indistinct writing or drawing can be more difficult to read.
(c) Use colour to separate different ideas. Colour also helps show the organization of the subject.
(d) Use symbols and images. Pictures can help you remember information more effectively than words.
(e) Use cross-linkages. You can draw in lines to show the cross-linkages. This helps you see how one part of the subject affects another.

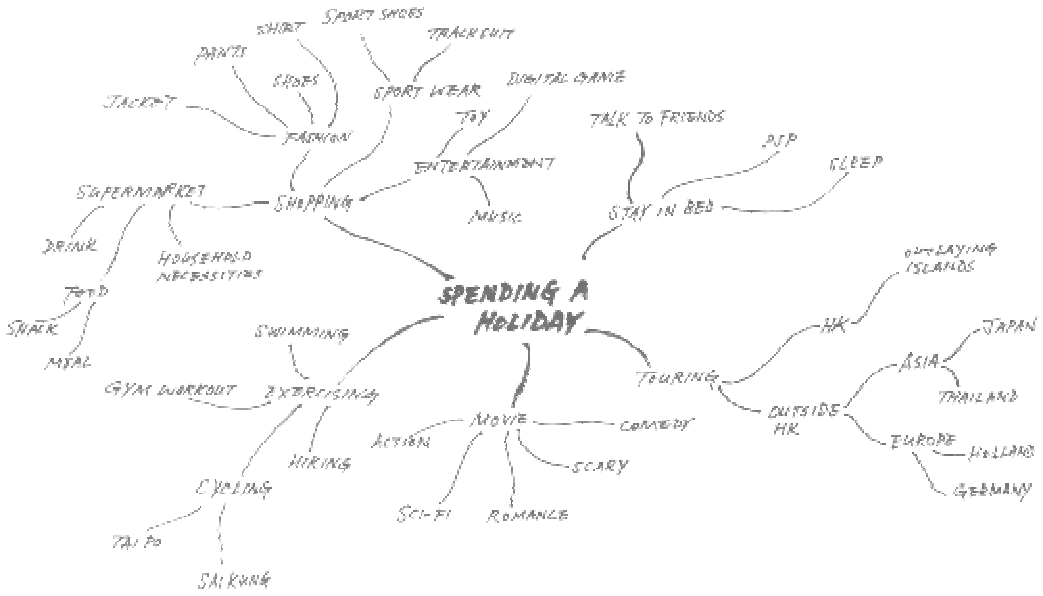


Figure 1.71 A mind map showing how it is being used. Note the diversion of thinking that spread from one point outwards.

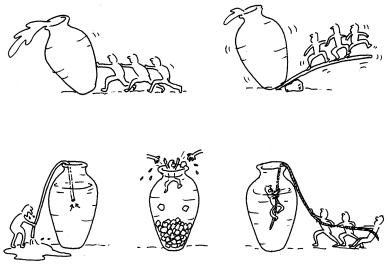
S T O P A N D T H I N K

Mind mapping possibilities

Saving the boy in the urn

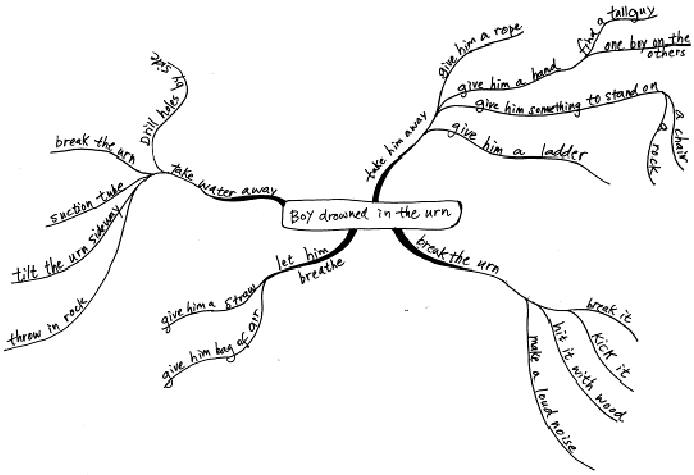
The famous story of Sze Ma Kong (司馬光), who broke an urn to save his friend, shows his wit in lateral thinking.

Sze Ma Kong broke the urn with a rock, draining away the water and saved the boy. In fact, he could have other alternatives.



Fung, Alex et. Al. *Creative Tools*. Hong Kong: School of Design, The Hong Kong Polytechnic University, 2005.

These solutions can be very imaginative in a way. They are results of lateral thinking using brainstorming or mind map.



A mind map developed for saving the boy in the urn. Note the way in specifying the things that Sze Ma Kong could do: It describes only an abstract action like ‘take him away’ or ‘let him breathe’. Thus the possibilities at the end of the branches increase.

C. Analogy

Analogy is a way of getting the idea moving instead of staying still wondering what can be done. It offers different ways to seeing the same problem. For example, the problem with designing juicing an orange can be put as analogies of

(a) digging oil from the ground,
(b) getting water from a water tap, and
(c) sucking soft drink with a straw.

As you may have immediately noticed, the problem of juicing an orange becomes digging oil from the ground. It provides another insight into the problem. We normally juice an orange with our own hands or with a mechanized juicer. Either way applies all forces to the orange to squeeze the juice out. With the analogy, we can overcome the problem by an external pumping force that involves the breaking up of the crust (orange peel) first. If you revisit the problem, this insight will lead you to think differently.

H I G H L I G H T

If you use analogy as a thinking tool, there are certain guidelines to follow:

(a) Analogy is best used to deal with function and process.
(b) The core of using analogy is to solve a problem. Therefore, the problem must be identified correctly in the first place.
(c) Analogy is solely a starting point of the thinking process for a problem. Do not hesitate on whether the analogy is rhetoric or not.
(d) Think of several analogies at the same time, allowing you to see a problem at different perspectives.
(e) Analogy does not have to be long and complicated, but it must proximate the problem.
(f) Some analogies go far enough to bring the designer astray. You will need to check, back and forth, if the analogies correlate to the problem or not.

Here are some problems for your tryouts. Try to write as many analogies as possible for each of the following. You will discover new angles of seeing the same problem:

(a) Finding way in a city;
(b) Avoiding getting wet in the rain; and
(c) Diving underwater for a long time.

D. Adaptation

Adapting to the environment is the basic instinct of all human. Likewise, adapting a design problem and design process in non-conforming ways yields unexpected and sometimes creative solutions.

A designer can make adaptations at different stages of design so that the outcomes can be more stimulating.

E. Redefining the design problem

Is the concept we were told or taught really true? For example, the sun rises in the East and sets in the West; the earth is a sphere; leaves are green; butterflies are usually colourful; and humans walk on two legs and talk in their language.

Does it ever occur to you that the sun rises in the East because we call that direction East? The earth is a sphere because we are looking at it from outside of it. Leaves are green because we can see colours. Some butterflies are colourless without daylight. The ability to walk and talk makes no sense to a dog because it walks on four legs all its life and barks when it wants to express its feeling!

Redefining a problem leads you to see it from other perspectives. Quite different from analogy discussed earlier, redefining a problem aims at bringing you around, on top of and below a problem. It also sets aside the conventional perception of a subject and releases you from the burden of traditions. With a different problem, you can begin a complete different course of developing solutions.

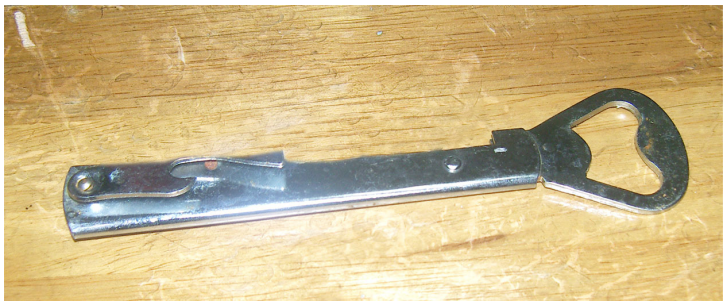
Examples of redefinition of a problem:

Convention	**Redefinition**
I am getting old.	I have seen more of this world.
The dog is noisy.	My hearing is too good.
My car is too slow.	Your car is too fast.
The street is too dirty.	Public concern for healthy environment is low.
Crime is on the rise.	There are not enough policemen on the street.

H I G H L I G H T

A lot of lifestyle products are designed by redefining the problems. They are certainly funnier to use than, while providing the same function of, their predecessors.

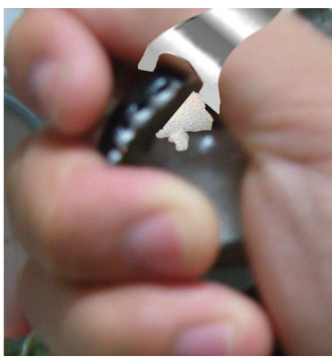
Bottle openers designed to the shape of a shark.



A conventional bottle opener.

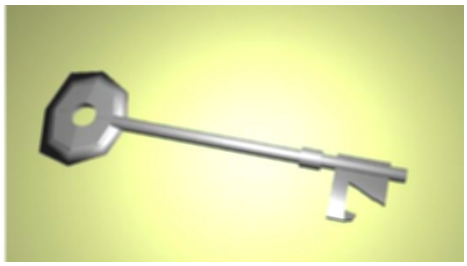
If you think deeper, you will discover that a bottle opener does not need the shape of a shark to work. A conventional bottle opener has a hole punched out of a flat piece of metal and one end longer for grabbing. *Opening a bottle*, thus, is the ultimate goal of the design.

The designer of the shark shape bottle opener has clearly another objective in mind. The thinking is to design a '*handy yet cool-looking*' opener. Now with that redefined design problem, you can come up with a lot of solutions. The following are more examples of the same variation of 'handy yet cool-looking' bottle openers.



A ring bottle opener.

A bowling-pin bottle opener.



A key shape bottle opener

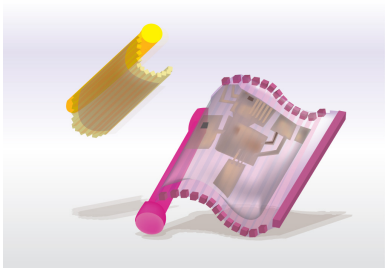
S T O P A N D T H I N K

Exploring other possible definitions to a problem

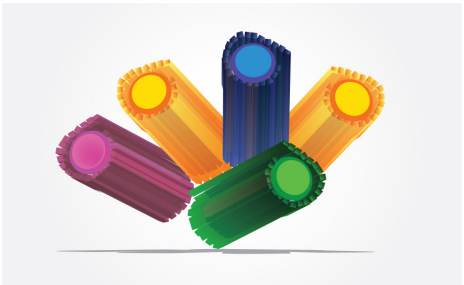
'There is not enough space for the key pad'

If you are designing a PDA phone and the client comes to you with the problem: 'there is not enough space for the key pad'. We all know that there are more keys in a PDA phone than a normal mobile phone. What can a designer do? In this case, try to redefine the problem in some statements. The first is done for you, beat the others by yourself in the *Follow-up activity*.

The design of a PDA phone. The designer solved the problem of not having enough space by layering the phone into two slices. Such change increased the surface for keypad. The design dealt with the problem head on without redefining the problem.



The designer saw the problem of keypad space on calculator and solved it with flexible plastic.



High flexibility of the material enables rolling up of the calculator. Thus, saving a lot of space.

Follow up activity

Convention	**Redefinition**
Not enough space for key pad.	The keys are too big.
a._____	_____
b._____	_____
c._____	_____
d._____	_____

Consider the redefinitions carefully and choose the one that allows an extraordinary idea. Draw a simple diagram in the following space to represent your concept.

H I G H L I G H T

Personality traits of a creative designer:

(a) Curiosity,
(b) Constructive discontent,
(c) Enjoy challenges,
(d) Optimistic,
(e) Suspend judgment,
(f) Comfortable with imagination,
(g) Recognize problems as opportunities,
(h) See problems as intriguing,
(i) Problem is acceptable,
(j) Challenge assumptions, and
(k) Perseverance

Not all designers possess these traits. Some of them, in fact, can be nurtured through practices.

1.4 PROJECT MANAGEMENT AND TEAM WORK

1.4.1 What is project management

Project Management is the discipline of organizing and managing resources (e.g. people) in such a way that the project is completed within the defined scope, quality, time and cost constraints.

1.4.2 Definition of Project management

PMBOK (Project Management Body of Knowledge as defined by the Project Management Institute – PMI):

"*Project management is the application of knowledge, skills, tools and techniques to project activities to meet project requirements.*"

A. What is a project?

A project here refers to the design project directly resulting in a creative solution concerning the following areas:

(a) Problem,
(b) User,
(c) Process,
(d) Material, and
(e) Environment.

B. Challenge of project management:

(a) To ensure that a project is delivered within the defined constraints;
(b) To ensure optimized allocation and integration of inputs needed to meet the pre-defined objectives; and
(c) To carefully define a set of activities that use resources (money, people, materials, energy, space, provisions, communication, quality, risk, etc.) to meet the pre-defined objectives.

1.4.3 Project management plan

A project management plan is a plan that covers topics used in project execution. The plan actually includes the following main aspects: Scope Management, Schedule Management, Quality Management, and Financial Management.

(a) Scope Management includes a clearly-set objective of the project and the scope covered.

(b) Schedule Management includes a clear-stage schedule, which usually appears in Gantt chart format.
(c) Quality Management includes the quality as well as the schedule control. A log sheet is usually used as a checklist to reflect the progress and suggestions for improvement.
(d) Financial Management includes the financial estimation and monitoring throughout the whole project.

1.4.4 Project management activities

As project management is closely related with design processes, all the activities listed below should be applied to all stages of a design process.

Project Management is composed of several different types of activities, such as:

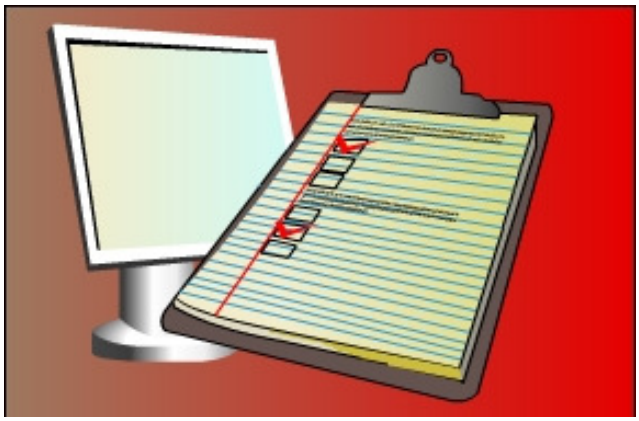
(a) Setting objectives,
(b) Planning the execution,
(c) Executing process,
(d) Teamwork, and
(e) Reviewing.

1.4.5 Setting objectives

Project objectives define the target status at the end of the project, reaching of which is considered necessary for the achievement of planned benefits. They have to be formulated as S.M.A.R.T, i.e.

(a) Specific,
(b) Measurable achievement,
(c) Achievable (or Acceptable),
(d) Realistic, and
(e) Time terminated (bounded).

The five elements include the planning with costing, time management and task analysis.



1.4.6 Planning the execution

The design process introduced earlier gives a clear picture on what has to be done. As the design work and process are quite complicated, they have to be completed in sequence. The design team should have a clear picture on when, where and what to do. In planning a design project, the following must be considered and listed:

(a) Steps and stages in the process of the project,
(b) Outcome in each stage of the project, and
(c) Time available for each stage.

H I G H L I G H T

Gantt chart is a popular type of bar chart that illustrates a project schedule. Gantt charts illustrate the start and finish dates of the terminal and summary elements of a project. Terminal and summary elements comprise the work breakdown structure of the project.

Some Gantt charts also show the dependency (i.e. precedence network) relationships between activities. Gantt charts can be used to show current schedule status using percent-complete shadings and a vertical "TODAY" line (also called "TIME NOW" or "DATA DATE"), as shown below.

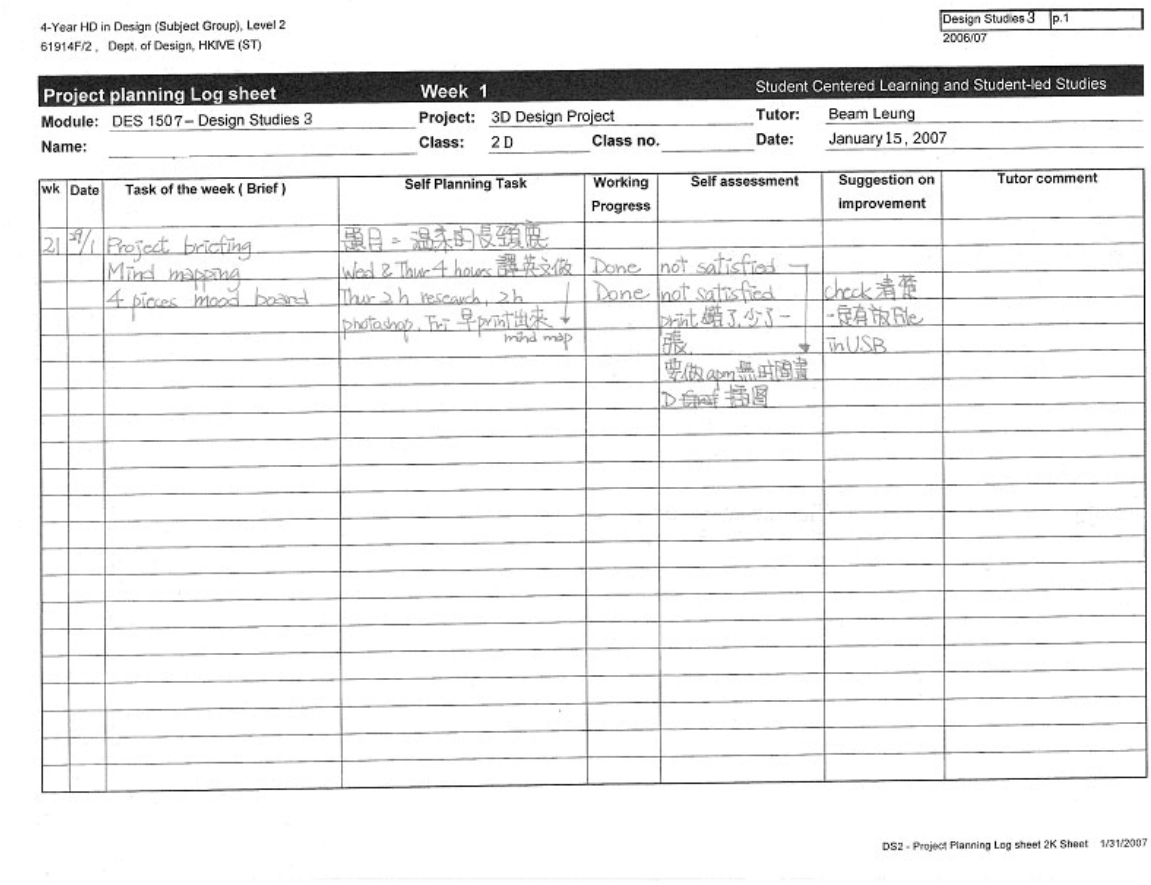
Figure 1.72 Gantt chart

1.4.7 Executing process

As the design project is divided into different stages, the Gantt charts help us separate and reflect the stages with timeline. All the stages will be cut into tasks that we have to execute. At the same time, all the tasks have to be listed clearly with the following:

(a) Date and time specifically assigned,
(b) Steps to achieve the task, and
(c) Quality and quantity of the task.

The log sheet below is an example of a process's planning and execution.



4-Year HD in Design (Subject Group), Level 2
61914F/2 , Dept. of Design, HKIVE (ST)

Design Studies 3 p.1
2006/07

Project planning Log sheet Week 1 Student Centered Learning and Student-led Studies

Module: DES 1507 – Design Studies 3 Project: 3D Design Project Tutor: Beam Leung
Name: Class: 2 D Class no. Date: January 15 , 2007

wk	Date	Task of the week (Brief)	Self Planning Task	Working Progress	Self assessment	Suggestion on improvement	Tutor comment
21	29/1	Project briefing Mind mapping 4 pieces mood board	星日 = 温柔的長頸鹿 Wed & Thur 4 hours 讀英文像 Thur 2 h research, 2 h photoshop, Fri 早print出來 ↓ mind map	Done Done	not satisfied → not satisfied print 錯了, 少了一張. 要做am無時間讀D final 特圖	check 清楚 一定有成File in USB	

DS2 - Project Planning Log sheet 2K Sheet 1/31/2007

Figure 1.73 Log sheet for recording the planning and reviewing of the design activities

1.4.8 Teamwork

Teamwork is the concept of people working together cooperatively, as in a sports team.

Many large, ambitious projects require that people work together, so teamwork has become an important concept in project management. Effective teams are an intermediary goal towards getting good, sustainable results. It appears that there are increasing efforts through training and cross-training to help people work together more effectively and accomplish shared goals, whether colleagues are present or absent.

A. Position of a team

Different members in a team have different characteristics. The best team work practice is to make use of the strengths of each member in fulfilling particular tasks in the whole process.

B. Coordinator

This person should have a clear view of the team objectives and be skilled at inviting the contribution of team members, rather than just pushing her/ his own views.

C. Implementer

This should be an individual who is well organized and effective at turning big ideas into manageable tasks and achievable plans.

D. Specialist

This person provides specialist skills and knowledge, and has a dedicated and single-minded approach.

S T O P A N D T H I N K

How do I know which position is suitable for me?

As we join in a new team, you will never know what ability the team member will have. It is good to do the following:

(a) Firstly get familiar with the team members;
(b) Keep reviewing the suitability of position for each member;
(c) Try to understand team members' strengths and weaknesses through cooperation; and

(d) Make changes of position as needed and as agreed by the whole team

For small teamwork, positions of any individuals can be swapped, combined and re-distributed. Especially on the specialist position, each team member can be a specialist if s/he really has a particular skill.

E. Work load distribution

In achieving a balance of the work load, team members have to understand that it is not averagely spread over the whole project.

Design stages	coordinator	implementer	Specialist (skill)
Planning	******		
Research	***	***	
analysis	***	***	***** (Analytical ability)
Idea generation	***	***	***** (Creativity)
Idea development	***	***	***** (Modelling ability)
Design presentation	***	***	***** (Visual Communication ability)

1.4.9 Case study – HiSonic

The HiSonic Head Gear provides the wear ability of a bone conduction hearing device for the profoundly deaf.

When the design team was firstly approached, the client already had a basic prototype of head gear for the profoundly deaf. However, the original design had a problem with the comfort ability and lacked design input on the ergonomic.

A. The team works

The design team in the Designology design studio divided the project into different stages, and personnel into different roles. While working in a team, they started with a design manager who was the coordinator of the whole design project. Other designers were implementers. All design activities were implemented by the designers. As the technology used involved a lot of special knowledge, different specialists were invited in different stages. Specialists provided valuable assistance through out the whole design progress.

Stage	coordinator	implementer	Specialist
Research	Design manager	designers	medical specialist, ergonomist, engineer on the ultrasonic technology
Conceptual design	Design manager	designers	medical specialist, ergonomist, engineer
Product development and Finalization	Design manager	designers	Model/ Prototype maker, CAD operator, CAE engineer, production engineer.

The technology used in the HiSonic hearing device is to convert speech and sound into ultrasonic vibrations. These vibrations, when transmitted by a transducer to the mastoid bone behind the ear, are perceived by the brain as sound. The transducer is held to the mastoid by the HiSonic Head Gear.

B. Management of the project

As coordinator, the design manager worked with the team closely according to the project schedule. The objective was clear and direct. It was also the main content of the design brief.

Design brief – to design a comfortable hearing device for the profoundly deaf of different ages from children to adult.

With the design brief, the design manager drafted a timeline with Gantt chart, which identified all the stages and key days.
While implementing the different stages, the design manager organized a series of study groups and sessions for different tasks.

Research: Specialist including ultrasonic technology engineers, ergonomists provided information and working models from their professions. These provided the designers (implementers) with knowledge of medical and technological aspects.

C. Concept Design – idea generation

Brain storming sessions and mind mapping activities were held to generate as many ideas as possible. These sessions usually invited different professional to attend. As experts with different backgrounds provided different views, lots of sketches were generated to visualize the design concepts.

D. Design – development

Sessions with ergonomists were held to study the human dimension for the head set. A lot of tests were held in finalizing the accurate dimension.

E. Product development and finalizing design

With the help of CAD operators, engineers were invited on technical details and the selection of material at this stage. Design engineers developed structural details of the design with CAD. CAE engineers conducted structural strength simulation test. Physical testing models were built for different ergonomic and material tests. Production engineers were invited to fine tune the selections of materials and production processes in terms of cost effectiveness.

Source and Reference:
http://www.designology.com/

1.4.10 Reviewing

As the design project comes to the end, a reviewing procedure must be done to summarize what has been learnt. Evaluation includes the result and the process.

A. Outcome evaluation

This reflects how good the final design is at the end. It can be done with different views:

(a) Teacher view,
(b) Peer view, and
(c) Target user view if possible

B. Process evaluation

This reflects the effectiveness and efficiency of the whole process. With taking account of the time resource, a performance indicator can reflect how good the team has done.

Source and Reference:
http://en.wikipedia.org/wiki/Project_management#Definitions

1.4.11 Cost benefit assessment

A cost benefit assessment is a method to assess how much benefit gain in terms of cost. Benefit here refers to lowering the cost during production and delivery.

A. Costs:

Production cost:

Production cost refers to the cost for producing the design. It generally includes the making of parts, assembly and packaging of the design.

Storage cost:

As the design is produced, the final product may not be delivered to clients immediately. A certain amount of products will be stored until they are delivered via different kinds of transportation. These products must be stored in an appropriate condition which should not cause any damages. The rental expenses on the storage space (usually inside the factory) will become part of the cost.

Delivery cost:

As the products are delivered to clients, a certain transportation method will be employed. The quicker it does the higher the cost. Getting on a flight delivery is more expensive than on a container ocean liner.

Example on the cost of a potato peeler with production of 500 units.

traditional potato peeler

	Item	process	Unit Cost (HK)	Total: (HK$)
Production	Material – stainless steel	Purchase from market	0.5	3.6
	The handle	Cutting Bending Finishing	0.3 0.3 0.3	
	Cutter	Cutting Stamping Forming Finishing	0.3 0.3 0.3 0.3	
Assembly	assembly		1.0	
Package	Buzzer pack	Material Production	0.5 0.5	1.0
Storage		Rent	0.5	0.5
Delivery		By ocean liner with container	2.0	2.0
			Total cost per unit (HK$)	7.1

Production rate and cost

When the design is mass produced, the cost on production will be lower. For example:

Quantity produced	Production	Packaging cost	Storage	Delivery	total
500	3.6	1.0	0.5	2.0	7.1
2000	1.8	0.5	0.5	1.5	4.3

In the selection of the suitable production process, we have to firstly decide the quantity unit produced. As different production methods will cost differently, a plastic moulding method is a cheaper solution for mass volume.

Cost cutting with design

Here are some examples on the cost considered during the design process.

Production cost:

i.) Moulding cost and assembly:

	
plastic moulded peeler	traditional peeler

When the production volume goes up to more than 1000, the potato peeler on the left is a cheaper design when compared with the peeler on the right. The plastic design is a cheaper solution in high volume production. The production materials, time and assembly require lower investment, whereas the metal peeler will require more complicate procedure like: metal cutting, bending, welding, finishing, as well as the parts assembly.

ii.) Packaging, storage and delivery cost

	
Buzzer pack package	Box package

The simpler the package, the less it costs. With a simpler package method and design, the production cost can be cut down, due to less materials used and quicker production process. With the clever design, the volume of the packed product can be lower, freeing up more storage space. Also, with the same storage space, a good packaging design can store twice in quantity; in other words, lower transportation cost too.
In terms of materials and space, the package design on the left is less when compared with the box package on the right. It means that there will be lower cost on package, storage and delivery.

B. The assessment:

With the listed costs for different designs, a comparison table can be drawn in assessing how the designs benefit the cost control. However, in the example below, we must have the quantity of production and the selling method determined.

Quantity: 1,000pcs

Selling channel: supermarket

	Design A 		Design B 	
	Unit Cost (HK$)	Total(HK$)	Unit Cost (HK$)	Total:(HK$)
Production	0.5	3.6	0.2	0.3
Assembly	1.0		0.1	
Package	1.0	1.0	1.0	1.0
Storage	0.5 (box pack)	0.5	0.2 (buzzer pack)	0.2
Delivery	2.0	2.0	1.0 (lighter & smaller pack)	1.0
	Total cost per unit	7.1	Total cost per unit	2.5

In conclusion, Design B will be cheaper for the costing, implying potentially a better profit in the market.

1.4.12 Hong Kong industries' development in Pearl River Delta

Gold Peak Industries (Holdings) Limited is a major high-quality industrial investment by the Gold Peak Group. The company is a successful case in terms of making use of the strong manufacturing support from Shenzhen and Dongguan. The design team on the GP batteries chargers are located in the Hong Kong headquarters office in Kwai Chung. They produce designs from chargers to other battery-related products and successfully market their products. Most of the designs were produced in Dongguan. Like many other companies in Hong Kong, Gold Peak has invested in the manufacturing plants in Pearl River Delta as early as in the 1980's. The production plants have taken up the role of the factory in Hong Kong and are going to spread in other cities in China.

Reference: www.gpbatteries.com.sg/coreproducts.htm

1.5 DESIGN IN PRACTICE – ROLE OF DESIGNERS AND ENGINEERS

1.5.1 What is a designer

A designer is the person who creates design for a variety of things. Designs include 2D, 3D to media and interactive aspects. This implies the task of creating or of being creative in a particular area of expertise. Generally speaking, there are architectural designers, visual communication designers, product designers, interior designers and fashion designers. A designer is the one who generates new ideas and communicates with others through 2D medium and/ or 3D models or prototypes. Designers are usually responsible for creating design solutions and taking into consideration each step during a product's development, including not only how a product will be used but also how it will be made.

A designer is responsible for the interface parts of a design, where the visual, tactile and emotional contents of the design are being effectively delivered to the users.

1.5.2 What is an engineer

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

Engineers are responsible for the technical part of a design, which to ensure the design works properly after produced.

1.5.3 The similarity between designer and engineer

(a) Both are involved in the whole design process. Designers and engineers work together from the start to the end of the project, especially when a project starts with innovation and a new market. For innovation, they will go through the creative process together in generating new concepts.

(b) Both have clear objectives for each task. As the innovation process goes into details of development, designers and engineers will have different tasks to fulfil, where mostly working independently, but does not mean individually. They will work together in cooperation on determining the size, the functions, etc.

(c) Both are involved in high creativity in solving problems. Both designers and engineers are strong in problem solving. Although with a different perspective, they work together through out the creative process in generating design solutions.

1.5.4 The line

Any designs will have the line drawn in differentiating the two roles. The line is different in different cases as in various industries. It may also vanish in certain design disciplines, especially when craft is heavily involved, e.g. jewellery design.

A. Above the line

Designers' role is described as above the line in a design. It is targeted to create a design in close relationship with the users. Designers must consider the following from the user perspective:

(a) Ergonomic needs,
(b) Physical needs,
(c) Cultural needs, and
(d) Emotional needs

B. Below the line

Engineers' role is described as below the line in a design. It is targeted to make a design become reality. They have to ensure that the design technically provide the users with a safe and reliable service. Engineers must consider the following on the design:

(a) Workability,
(b) Production feasibility,
(c) Technical safety,
(d) Reliability, and
(e) Production cost

1.5.5 Case study

A hair dryer is used as a study below to illustrate the role of designers and engineers.

A. Above the line

Once receives the brief on designing a hair dryer, the designer will go through the consideration below:

(a) Ergonomic needs
    (i) How many users are involved during the process?
    (ii) How should the design be handled in the process of drying hair?
    (iii) What equipment will be used together during the process?
    (iv) How comfortably, effectively and efficiently should the hair dryer work?
(b) Physical needs

(i) How will the housing contain all the components?
(ii) How should the size and materials fulfil the users' needs?

(c) Cultural needs
(i) How should the visual appearance be in attracting users, including form, colour and visual elements?
(ii) How does the culture affect the users in using the hair dryer in their everyday life?

(d) Emotional needs
(i) How should the interface be designed in reflecting the status of the hair dryer?
(ii) How does the image of the hair dryer bring emotional response from the users? 'Image' includes visual appearance, interface and tactile.

Figure 1.74 Example of hair dryer design

B. Below the line

An engineer is involved in the design process with different perspective. They concentrate on the workability of the hair dryer with the following:

(a) Workability
(i) Is the design actually working with all components fit in?
(ii) Production feasibility
(iii) Can the hair dryer be produced?
(iv) How effectively and efficiently it will be produced?

(b) Technical safety
Does the design fulfil both the general safety and the electrical standards?

(c) Reliability
How reliable is the hair dryer? This includes the delivery from factory to the users and the life of the hair dryer being used correctly.

(d) Production cost
Do all the technical issues fulfil the targeted production costs, including: materials used, production method, assembly process and packaging?

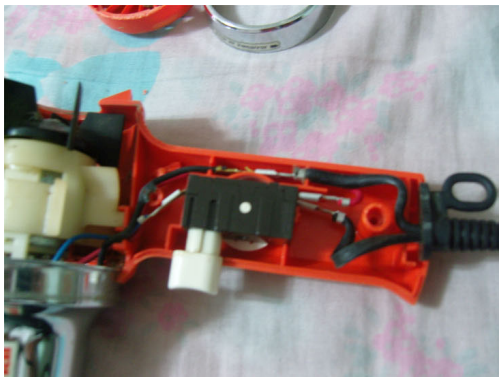



Figure 1.75 the internal parts of a domestic hair dryer with electrical components and assembly parts up to the international electrical appliance standard.

Reference:
http://en.wikipedia.org/wiki/Designer

1.5.6 Case Study – BMW K1200LT Motorbike

The BMW K1200LT motorbike is one of the most luxurious motorbikes produced. Other than BMW, there is only the company Honda will manufacture both car and motorbike. In terms of technology, BMW finds that this can benefit both markets as the technology can be shared. A 1200 c.c. motorbike with no question is a giant. It contains a 4-cylinder engine and ABS brake system (Anti Braking System), which are mostly used in making cars. With other luxurious equipment like the electronic adjustable windshield, 6-disc CD player, the K1200LT is one of the well equipped motorbikes in the world. Using the above / below the line theory mentioned earlier, K1200LT has clearly showed the different roles of designer and engineer during its design process.

When the whole project got started, there was a clear list from the research team reflecting what the market gap was. With the list, a clear specification on what the consumers needed was shown. The design brief stated that it was "to design a powerful, well equipped, comfortable motorbike for the middle class or above consumers". With this consideration, engineers and designers formed a design team with marketing specialists and other researchers.

Engineers, on one hand, had to list out what technology could be used in providing sufficient power, and the equipment list for comfort, e.g. the entertainment system. In addition, as the consumer was from at least the middle class, safety issue was another important issue to be addressed. As all these considerations were put into real practise, different technologies and items were packed together to form the basic configuration of the bike. Of course, as the most important part of engineering, the engine and transition systems became the main part. The chassis of the K1200LT was built up with all the efficiency and power. Here is where the line was draw and the engineering was below this line.

The main chassis of the K1200LT which are all consideration below the line.

What designers did was to work hard on the outer skin of the motorbike. With the basic chassis as the base, designer worked on the form, space, control location, comfort, and style of the bike.

Control interface – The visual indication on the control panel coping with logical workflow and feedback.

Ergonomic – handle control must be well arranged for ergonomic. The seat, back rest, foot pedals must be well located with suitable materials.

Visual language – the form, shape, lines, colour, finishing must deliver the message on a high quality, reliable machine which provide unlimited powerful image.

Corporate image – the elements above not only tell story on the bike itself, but also match up with the identity of the BMW auto series in delivering the complete image of the corporation. This is not only the job of the logo and typeface, but also a complete product strategy of the company.

1.5.7 Class activity

Brief:

Students are asked to bring a simple tool from home. The tools should be selected as the students consider good design. It should also contain at least 4 parts.

Students should form into a group of 2

Students should point out the following with one of them acts as the designer and the other acts as the engineer.

For Designer:

List out the following from the simple tools

(a) Ergonomic issue
(b) How the tool should be used?
(c) What do you think the design of the tool affects its use?
(d) Comfort
(e) Effectiveness
(f) Efficiency
(g) Physical issue
(h) How is the tool stored?
(i) Is there any design in the tool considering the storage?
(j) Cultural needs
(k) Is the visual appearance look attractive to you?
(l) What kind of users do you think the tool is designed for?
(m) Are there any items designed in the tool attractive to you: form, colour, materials?
(n) Emotional needs
(o) Do you think the design of the tool brings any emotional response to you, e.g. it looks like something familiar?

For Engineer:

List out the following from the simple tools

(a) Workability
(b) Is the tool actually working well functionally
(c) Production feasibility
(d) How was the tool produced?
(e) Technical safety
(f) Do you think the tool is safe? Why?
(g) Reliability
(h) Do you think the tool is reliable during the working process?
(i) Production cost
(j) How much is the price of the tool?

CHAPTER 2 – DESIGN CONSIDERATIONS

This chapter covers topics on:

2.1 Design Brief and Specifications
2.2 Solving Design Problems
2.3 Human and Environmental factors
2.4 Product Standards
2.5 Design Evaluation

These topics include learning materials and activities that facilitate your:

(a) Understanding and preparation of the design brief with suitable consideration;
(b) Solving of design problems with creative methods;
(c) Understanding and application of human and environmental factors in the design process;
(d) Understanding of international and regional product standards; and
(e) Evaluation of design ideas in an effective way.

Design is about solving problems, whether it is physical, practical or psychological. Before starting to design, identifying what we face is the key point to make a smooth beginning. Problems, when considering people, are ignited by human's needs. A need is normally not obvious at all and requires investigation. During the process, factors below must be determined:

(a) What is the major problem found in the existing design (e.g. a product)?
(b) Will the problem originate from certain needs of the users?
(c) Will there be other users, environment, product standards considered during the process?

As the tasks (or problems) clearly identified, a design brief will be naturally formed and the follow-up procedure is quite straightforward. In this Chapter, we will concentrate on discussing how a design project gets started and what the considerations are during the design process.

2.1 DESIGN BRIEF AND SPECIFICATIONS

A design project will not start by itself. There are usually some reasons causing some problems and requiring a designer to solve it finally. You as the designer may not exactly know what the reason behind it. So we must firstly make clear what is happening and what the problem is. A design brief is usually the first step to get things started.

Here are some terms that we will start talking before we go in depth.

(a) Design brief,
(b) Problem,
(c) Needs, and
(d) Design consideration

2.1.1 What is a design brief?

Design brief – A comprehensive written document for a design project developed in concert by a person representing the business need for design and the designer. The document is focused on the desired results of design.

However, a designer should be more sensitive to the ways these elements are being put together. The designer must, therefore, be adept at using them for specific purposes. (http://en.wikipedia.org/wiki/Design_brief)

H I G H L I G H T

Design brief in real practice

In real practice, design is part of a commercial sector within business. Designers take part in the creative process and serving clients. A design brief is a critical statement between the two parties and clearly explains how the design project should be started.

Here is a definition of the design brief in business:

(Clear Design UK Ltd, http://www.cleardesignuk.com/design-brief.html)
A design brief is a written explanation - given to a designer - outlining the aims, objectives and milestones of a design project.

A thorough and articulate design brief is a critical part of the design process. It helps develop trust and understanding between the client and the designer - and serves as an essential point of reference for both parties.

Above all, the design brief ensures that important design issues are considered and questioned before the designer starts work.

2.1.2 Definition of needs

A need is the psychological feature that arouses an organism to action toward a goal and the reason for the action, giving purpose and direction to behaviour.

The most widely-known academic model of needs was proposed by Abraham Maslow. According to the model, people have a hierarchy of needs, which range from security to self actualization. (http://en.wikipedia.org/wiki/Needs)

2.1.3 Maslow's Hierarchy of Needs

Maslow's hierarchy of needs is often depicted as a pyramid consisting of 9 levels: the four lower levels are grouped together as *deficiency needs* associated with physiological needs.

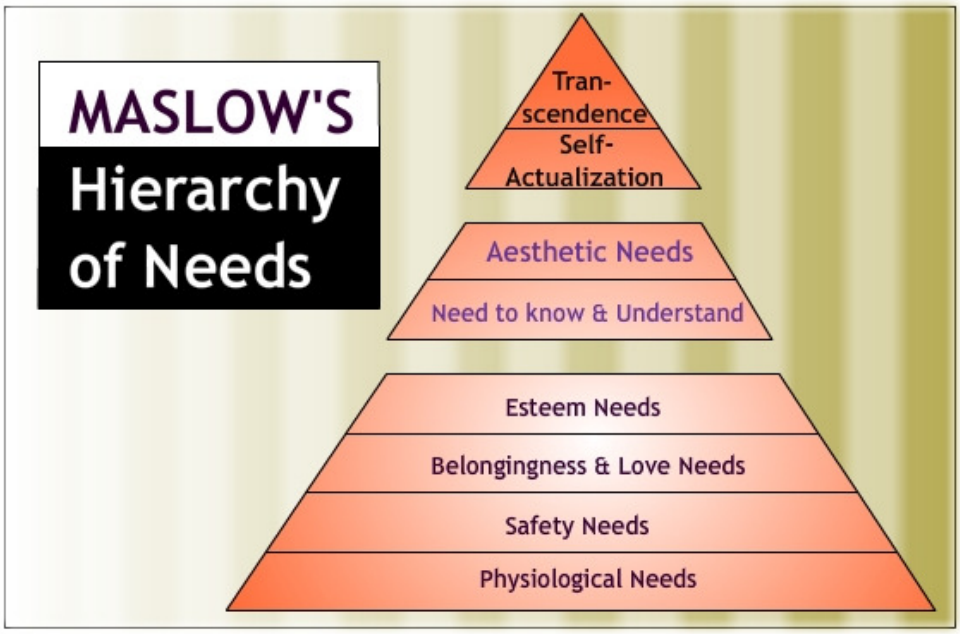


Fig. 2.01 Maslow's Hierarchy of Needs

The top level is termed *growth needs* associated with psychological needs.

The basic concept is that the higher needs in this hierarchy only come into focus once all the needs that are lower down in the pyramid are mainly or entirely satisfied. Once an individual has moved past a level, those needs will no longer be prioritized.

However, if a lower set of needs is continually unmet for an extended period of time, the individual will temporarily re-prioritize those needs - dropping down to that level until those lower needs are reasonably satisfied again. Innate growth forces constantly create upward movement in the hierarchy unless basic needs remain unmet indefinitely.

H I G H L I G H T
Maslow's Hierarchy of Needs Maslow's Hierarchy of Needs is a theory in psychology that Abraham Maslow proposed in his 1943 paper *A Theory of Human Motivation*, which he subsequently extended to include his observations of humans' innate curiosity. The concept for Maslow's hierarchy of needs work was based on Kurt Goldstein's organismic theory of personality ("The Organism"(1938)).

A. Physiological needs

The physiological needs of a person are the most basic needs from our body. If other needs are not fulfilled, human's physiological needs take the highest priority. Physiological needs can control thoughts and behaviours, and can cause people to feel sickness, pain, and discomfort.

B. Safety needs

When physiological needs are met, the need for safety will emerge. When one stage is fulfilled, a person naturally moves to the next. Safety and security rank above all other desires when associated to physiological needs, such as security of personal property against crime.

C. Love/Belonging/Social needs

After physiological and safety needs are fulfilled, the third layer of human needs is social. This involves emotionally-based relationships in general.

H I G H L I G H T
Here are some examples for the social needs: (a) Friendship, (b) Sexual relationship, (c) A supportive and communicative family, and (d) A sense of belonging and acceptance, whether it comes from a large social group (such as clubs, office culture, religious groups, professional organizations, sports teams, gangs) or small social connections (family members, intimate partners, mentors, close colleagues, confidants).

They need to love and be loved (sexually and non-sexually) by others. In the absence of these elements, many people become susceptible to loneliness, social anxiety, and depression.

D. Esteem needs

All humans have a need to be respected, to have self-respect, and to respect others. People need to engage themselves to gain recognition and have an activity or activities that give the person a sense of contribution, to feel accepted and self-valued, be it in a profession or hobby.

E. Cognitive needs –to know and understand

We have the need to increase our intelligence and thereby chase knowledge. Cognitive needs is the expression of the natural human need to learn, explore, discover and create to get a better understanding of the world around them.

F. Aesthetic needs

It is stated in the hierarchy that humans need beautiful imagery or something new and aesthetically pleasing to continue up towards Self-Actualization. We need to refresh ourselves in the presence and beauty of nature while carefully absorbing and observing our surroundings to extract the beauty from the world around us.

G. Self-actualization

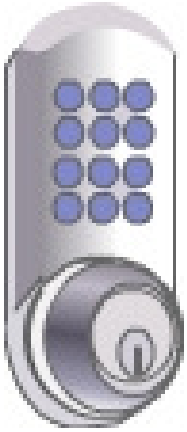
Self Actualization is the basic growth of what is already in the organism, or more accurately, of what we are.

Self-actualization is the instinctual need of humans to make the most of our abilities and to strive to be the best we can.

H. Self-transcendence

At the top of the triangle, self-transcendence is also sometimes referred to as spiritual needs. Spiritual needs are a little different from other needs, accessible from many levels.

2.1.4 Examples with Maslow's Hierarchy of Needs in product design

Physiological needs	 Figure 2.02 Cotton Bud	A cotton stick fulfils the hygiene needs for personal care.
Safety needs	 Figure 2.03 Keyless number pad lock	A door lock fulfils the needs for safety and security.
Love/Belonging/ Social needs	 Figure 2.04 Card game	Social games fulfil the needs for social activity and friend enjoyment.
Esteem needs	 Figure 2.05 iPhone	"iPhone" is representing the status of a person who is at the front-end of the popular culture and advance technology. Person with this product will be identified as part of certain social group and will be respected by the others.

Cognitive needs	 Figure 2.06 Sudoku on electronic device	A Sudoku device is not exactly for fun or a toy. It is actually a product for intelligent training fulfilling the cognitive needs.
Aesthetic needs	 Figure 2.07 A collection of decorative lamps	Domestic decorative lamps are almost purely designed for aesthetic needs where the aesthetic effect is the main concept on the product.
Self-actualization needs	As the definition identifies, there will not be any solid examples of products for the self-actualization needs, where all the above examples will be part here, but the person with self-actualization will have the following characteristic: Awareness, Honesty, Freedom, Trust	

Self-transcendence needs	 Figure 2.08 Lamp with Lotus Design	In fulfilling the religion needs, products related to religion will be classified as fulfilling the Self-transcendence needs here.

S T O P A N D T H I N K

With the images of products below, try to list out which needs each product is fulfilling and explain why.

Figure 2.09 electrical shaver

Figure 2.10 A Prestigious Watch

Figure 2.11 An electronic scale

2.1.5 Problem

Whenever there is an unfulfilling need, there will be problems. Most of the needs in the modern world are fulfilled with different designs. Designs do not directly means a product in the market. There may be some designs not being produced as products in the market as they are not suitable in terms of, for example, price and features. However, not all needs will be fulfilled by products in the market, as there will be new needs according to different social and culture changes.

Both the "Needs" and "Problems" are investigated for drafting the "Design brief". Refer to Topic 2.1.1 "What is a design brief" and 2.1.2 "The definition of needs" for details.

The following examples explain how needs are created and evolved:

Example 1

Needs:	People need to communicate over a distance.
Problems:	As people want to speak to each other over a distance, they cannot do it direct and have to travel to meet each other.
Design:	Telephone has been invented and well designed with all the features and handset design fitting the users.

Figure 2.12 Conventional telephone set

Figure2.13 Traditional telephone set

Example 2

Needs:	The basic communication need as a telephone already fulfilled, another need on communication anywhere at anytime is required by the user.
Problems:	User cannot communicate with other anytime, anywhere.
Design:	Mobile phones are designed to provide communication service anytime anywhere.

Figure 2.14 A typical mobile phone

Example 3

Needs:	There are needs for other portable entertainment by the user.
Problems:	Users do not have any portable entertainment which is convenient to be used.
Design:	Mobile phones are designed with music function and accessories.

Figure 2.15 A mobile phone with entertainment functions

The needs are not usually as obvious as the example shown above. Most of the time they are hidden within our activities. However, whenever we find a problem, we can discover the need.

2.1.6 Finding and investigating problems

Finding problems to tackle is the starting point for all design activities. Design problems exist everywhere you look, for they are concerned with how people live their lives and how products and systems help them do it. In any situations that you can imagine, think about what people are trying to do, how they are doing it, what systems or products they are making use of and how they might be improved. You will almost certainly find lots of design problems to tackle.

There are 2 areas where we can find problems:

(a) From observing our daily life
(b) From analysing the existing products

2.1.7 Key words involved in finding problems

In investigating problems, we have to understand the following items which we all live in:

(a) **A system** is where we all are in our domestic environment, such as living in a multi storey apartment in Hong Kong. Within the system, we have all the essential supplies including water, electricity, gas and drainage.

(b) **A task** is the aim that we go for and which is the ultimate result we have to achieve, such as having fresh orange juice.

(c) **A process** is the procedure that we have to follow in order to achieve the task, such as having a fresh orange, cutting or peeling the skin, swashing the orange, filtering to become the fresh juice, then serving in glasses.

(d) **A user** is the one who is involved in the process. It is not necessarily be a person. If a design is for pets, the user may be a dog. A major user is the one who is majorly involved in the process, such as housewives in preparing juice. A minor user is the one who may also be involved in the design, such as maintenance technician.

(e) **A situation** is the environment where the process takes place. Sometimes it may include several locations and different time, such as making juice in the kitchen and serving in the dinning room.

2.1.8 Finding problems and analysis

As mentioned above, we are actually discovering the needs via finding the problems. There are procedures that we can follow in finding the problem. The key words above can lead us to ask a series of questions. The questions may start with: What, where, who, whom, when and how.

A. The user:

Who? How many? What size? What age?

B. The process:

What? When? How? How often? What's the difficulty? What is the cost? How long does it take?

C. The situation:

Where? Why? Where else? What environment? What cost? What's the difficulty?

The above questions can help discover more problems and thus user needs.

2.1.9 Content in a design brief

The design brief should be clearly stated, and as broad as possible to allow different design solutions. After listing out the questions which involve many problems, we are able to refine them in the design brief. The design brief should include the following:

(a) Task,
(b) Design criteria,
(c) Final Design outcome, and
(d) Project schedule.

A. Task has been described in previous section.

B. Design criteria are the criteria that the final design has to fulfil. These are all listed out from the analysis stage with all the questions. In completing the design brief, we have to list them out as a firm statement. They will also be used to evaluate different ideas throughout the design process.

C. A design outcome is the listed items on the final outcomes of a design project. As different design projects may have different levels of outcomes, it is not always having a very completed prototype as the outcome. Some projects finish at an earlier stage like the idea sketch, development drawing or test model.

D. A project schedule is the schedule with all the necessary design stages listed out and well planned as a time schedule. Gantt chart is usually used in planning and monitoring the progress of a project.

Figure 2.16 Example of the Gantt chart

2.1.10 Sample of design brief

A. Task:

To design a device in making orange juice from a fresh orange.

B. Design criteria:

The device should fulfil the following criteria:

(a) User – the device
  (i) should be used by housewives;
  (ii) should be well fit on the user's human dimension; and
  (iii) should be comfortable to be used.

(b) Situation – the device
  (i) should be used in the kitchen without using electricity;
  (ii) should make one glass of orange juice (500ml) within 5 minutes; and
  (iii) should be no bigger than 12cm x 12cm x 12cm for easy storage in the kitchen.

(c) Process – the device
  (i) should help the user to prepare orange juice throughout the whole process from cutting to final cleaning; and
  (ii) should be convenient and comfortable to use, and easy to be cleared.

(There can be more design criteria to be listed with the questions and problems found. The criteria should be as detailed as possible in order to have a more accurate design solution.)

C. Final design outcome:

(a) Finalized design brief;
(b) Research and analysis report;
(c) Idea sketches (30 ideas);
(d) Development sketches (5 preliminary design);
(e) Drawings of the final design;
(f) Explanation through visual presentation; and
(g) Mock up/ prototypes of the final design

D. Project schedule

Week	1	2	3	4	5	6	7
Design brief							
Research and Analysis							
Idea sketch							
Design development							
Test model							
Final design presentation							
Final design mock up/ prototype							
Final presentation							

2.2 SOLVING DESIGN PROBLEMS

2.2.1 Where are the problems from?

As described in the last section on design brief, problems are found in developing the design brief. Although the design brief should be as broad as possible, we will start generating solutions immediately when we find a problem.

In searching for problems, the following can be done:

Observation – observe the situations, processes, users in our daily life
Interview – talk to users when investigating problems
Testing – analyse the existing products to discover new problems.

Evaluation on problems

When we find different problems, we have to start evaluating them in order to have clear direction to work on. A suitable problem for design project should be the one that should allow as many solutions as possible within the design criteria.

2.2.2 Design ideas

It is very rare that good ideas are completely new or original. They are usually a combination of existing ideas in different ways or applied to different situations. The following are the process in generating design ideas:

(a) Expand ideas by thinking up as many possibilities as you can;
(b) Connect ideas by combining possibilities; and
(c) Compare between ideas in order to choose the most promising one.

Idea generation is not a process done in front of your desk. Instead, it should be a continuing process which should not be restricted by where or when you are. It is important to record all the ideas on paper, usually in sketch form.

2.2.3 Brainstorming in idea generation

There are people who are creative and can generate ideas easily. For other persons, a more systematic method can be employed in generating design ideas. Methods introduced below are commonly used in creative industry. (Refer to Topic 1.3.2 Lateral thinking)

Brainstorming is a group creativity technique designed to generate a large number of ideas for solutions to a problem.

Other than the main function above, brainstorming has other potential benefits, such as enhancing the enjoyment of group work and improving morale. It may also serve as a useful exercise for team building.

Reference:

http://en.wikipedia.org/wiki/Brainstorming
http://www.brainstorming.co.uk/index.html
http://www.mycoted.com/Category:Creativity_Techniques

2.2.4 Mind mapping in generating ideas

A **mind map** is a diagram used to represent words, ideas, tasks or other items linked to and arranged radically around a central key word or idea. It is used to generate, visualize, structure and classify ideas, and as an aid in study, organization, problem solving, and decision making. (Refer to Topic 1.3.2 Lateral thinking)

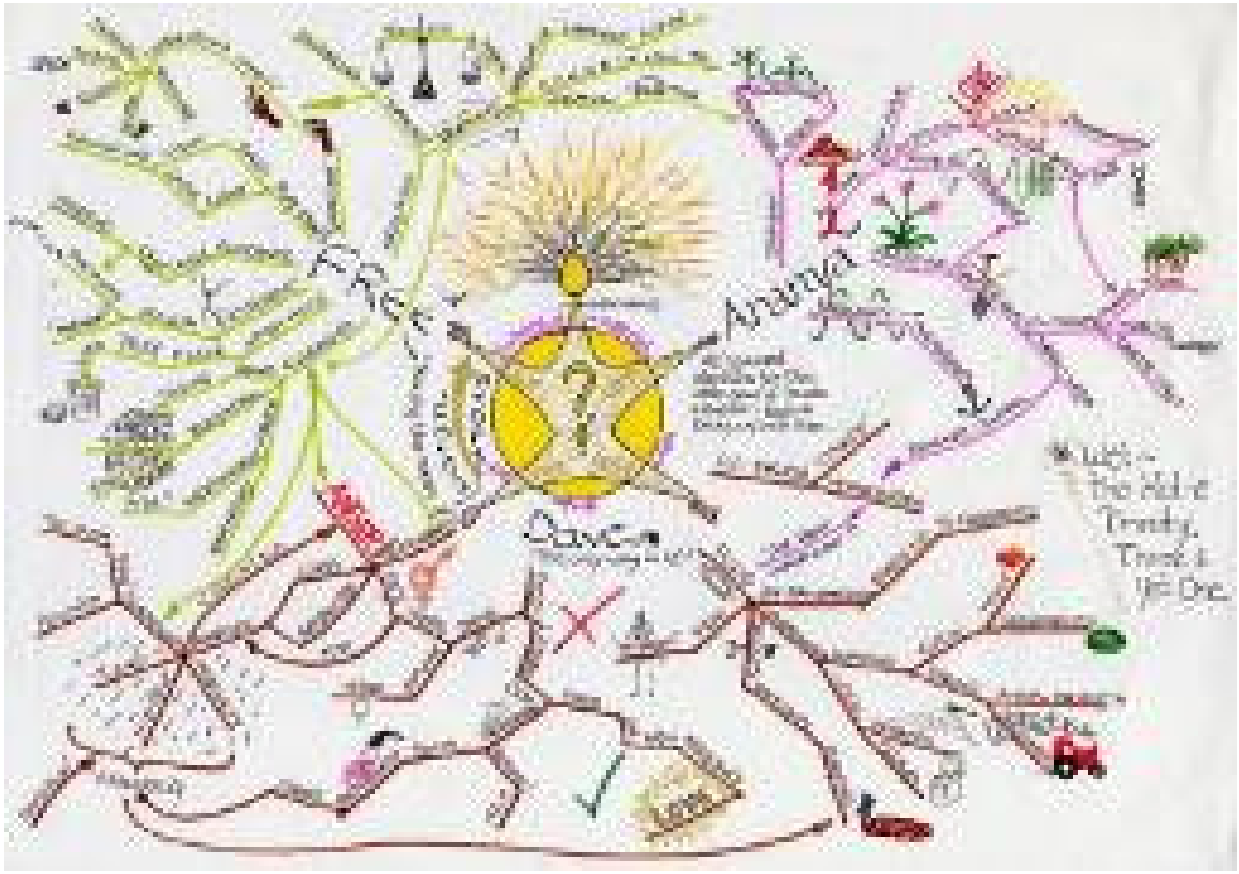


Figure 2.17 Example of a mind mapping diagram

Both brainstorming and mind mapping have been described in Chapter 1. While their details are not repeated here, other creative methods are introduced below.

2.2.5 Other creative methods in idea generation

Other than the brainstorming and mind mapping, there are other methods for idea generation:

A. Research and connect

Researching and looking for similar things that are related to the problem can bring up creative ideas. This is more effective when the problem you face is a very specific one, such as a jointing method for modules. By researching different jointing methods, you can explore and make use of some existing designs. This method relies on observation in our daily life as a continuous process.

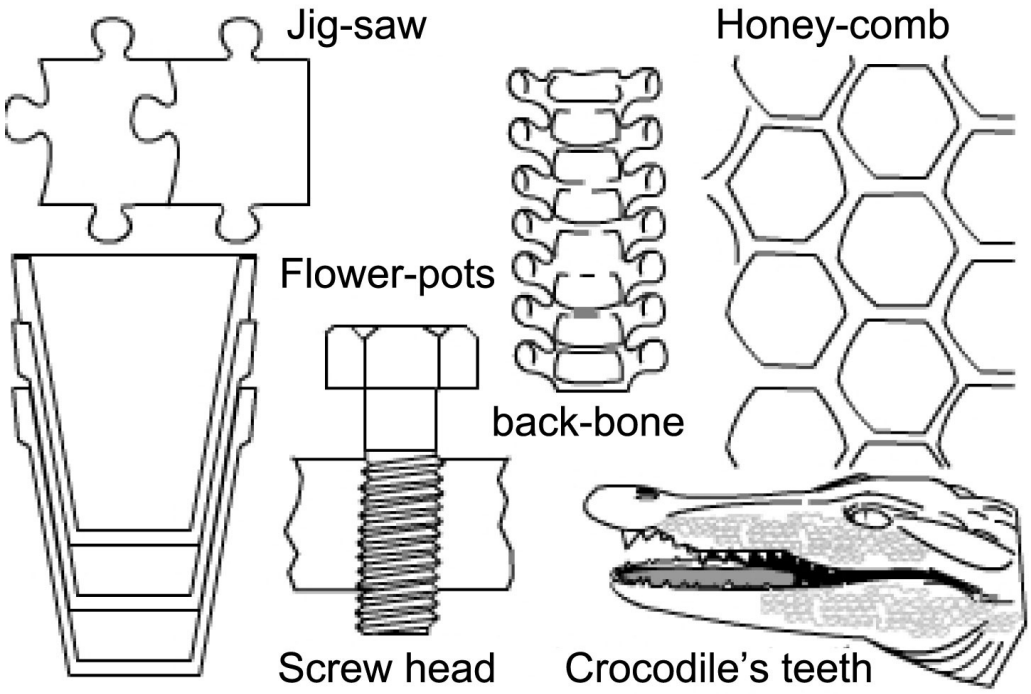


Figure 2.18 Example of how things are connected and the jointing methods.

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Research and connect

Here are two examples from the electrical and hardware industry on Research and Connect method in generating creative ideas.

The design uses an animal face for a lock. The design cleverly combines the bear face image with the form and details of a lock and becomes an innovative design.

Figure 2.19 A lock with the design as an animal face

The light design below connects the image of cloud with the electrical hanging lamp. The final design connects both the physical property of the lamp and the natural image of cloud.

Figure 2.20 A light with the design as cloud

B. Random method

Creative ideas are sometimes found not in a logical way. While the logical method only shows part of the possible ideas, there may be further score of creative ideas hidden. As we do not know how big the score is, we can never reach with a logical analysis sequence. It has to be flexible in using this method as its purpose is to lead to a new perspective on the problem instead of providing a very firm solution. It is encouraged on "happy accidents" and you can:

(a) Go to the cupboard and take out the first thing you see;
(b) Open a dictionary at random to look for the first work you see;
(c) Turn on the TV to look for the first picture you see; and
(d) Rearrange the letters of a keyword in your design brief to make another word.

H I G H L I G H T

Case Study in Design by Making Product Differentiation
(Reference: http://www.designcouncil.org.uk/en/Case-Studies)

Problems:

The DIY shop B&Q find that they were losing customers. There were new competitions coming up with similar power hand tools on the market. The design team studied their existing power hand tools with various researches. They found that the power tools were professional, but were too hard to use. With a more domestic household market growing (sometime with female and elderly customers), there were needs to make new easy-to-use design.

A power hand tool with new easy-to-use design

Response:

B&Q conducted an in-depth research project, leading to the development of an ergonomically designed product range for all customers.

Result:

B&Q has developed award-winning products, including design as part of its product development process.

The B&Q 'Gofer' cordless screwdriver and the 'Sandbug' sander were an immediate hit with customers. The products are not specifically labelled as having been designed for older people. It is because B&Q believes that easier to use products will benefit all its customers, regardless of age or dexterity.

'Gofer' cordless screwdriver

'Sandbug' sander

H I G H L I G H T

Case Study in Design by Technological Innovation
(Reference: http://www.designcouncil.org.uk/en/Case-Studies)

Problem:

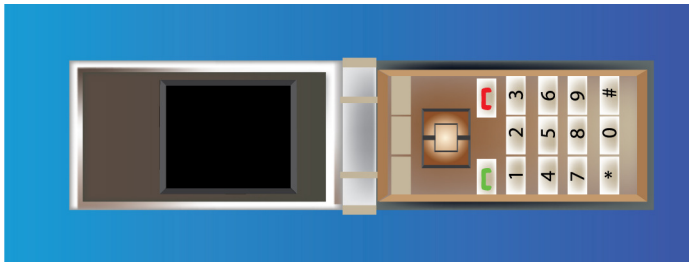
For handheld and mobile electronics, there are increasing abilities in storing personal information like photo and addresses. However in protecting the device from stolen, there are still difficulties. PIN and passwords can be used for these devices, but it will take too long to enter and were often disabled by users.

Response:

As every one has a unique fingerprint and now biometric software can scan it as a security step, this technology comes to a mature stage to apply onto some electronics.

Result:

Millions of mobiles, GPS and PC's now have fingerprint scanners incorporated to solve the security problem.



The mobile phone using fingerprint technology

2.2.6 Class activities

Activity 1: Work in a group of four.

A. Try the Random method on associating to the design of the following:

(a) A pair of scissors;
(b) A mouse for computer; and
(c) A clock

B. The random item can be using the following:

(a) Randomly open a page in a dictionary;
(b) Randomly pick a word in a textbook; and
(c) Randomly pick a freeze image from a movie (e.g. DVD)

Associate A and B together and draw out a new design. Try to draw as many as possible within 20 minutes.

Activity 2: Work in a group of four

Try the research and find 30 methods on the following:

(a) Jointing method;
(b) Handling cables; and
(c) Hinge

2.2.7 Home activities

Try out the following methods at home individually

(a) Research and connect; and
(b) Random method

A task should be direct and specific, for example, 10 methods for jointing

2.3 HUMAN AND ENVIRONMENTAL FACTORS

2.3.1 Human factors

"Human Factors" is the name of an engineering profession that focuses on how people interact with tasks, machines (or computers), and the environment with the consideration that humans have limitations and capabilities. Often, human factors study the humans within a system to ensure that we understand the limitations of humans within the current structure, product or process. Human-factors engineers evaluate human to human, human to group, or human to organizational interactions to better understand the phenomena associated with these interactions and to develop a framework for evaluation.

The term "human factors" is used mainly in the United States. Variants include "human-factors engineering", an extension of an earlier phrase, and "human engineering". In the rest of the world, the term "ergonomics" is more prevalent.
(http://en.wikipedia.org/wiki/Human_factor)

2.3.2 Ergonomics

Ergonomics (or human factors) is the scientific discipline concerning the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to designs in order to optimize human well-being and overall system performance.

Ergonomists contribute to the design and evaluation of tasks, jobs, products, environments and systems in order to make them compatible with the needs, abilities and limitations of people.

Practicing ergonomists must have a broad understanding of the full scope of the discipline. That is, ergonomics promotes a holistic approach in which considerations of physical, cognitive, social, organizational, environmental and other relevant factors are taken into account.

Domains of specialization within the discipline of ergonomics are broadly the following:

(a) Physical ergonomics is concerned with human anatomical, anthropometric, physiological and biomechanical characteristics as they are related to physical activity. Relevant topics include working postures, materials handling, repetitive movements, work related musculoskeletal disorders, workplace layout, safety and health.

(b) Cognitive ergonomics is concerned with mental processes, such as perception, memory, reasoning, and motor response, as they affect interactions among humans and other elements of a system. Relevant topics include mental workload, decision-making, skilled performance, human-computer interaction, human reliability, work stress and training as these may relate to human-system design.

Reference: International Ergonomics Association,
http://www.iea.cc/browse.php?contID=international_ergonomics_association

2.3.3 Ergonomics and design

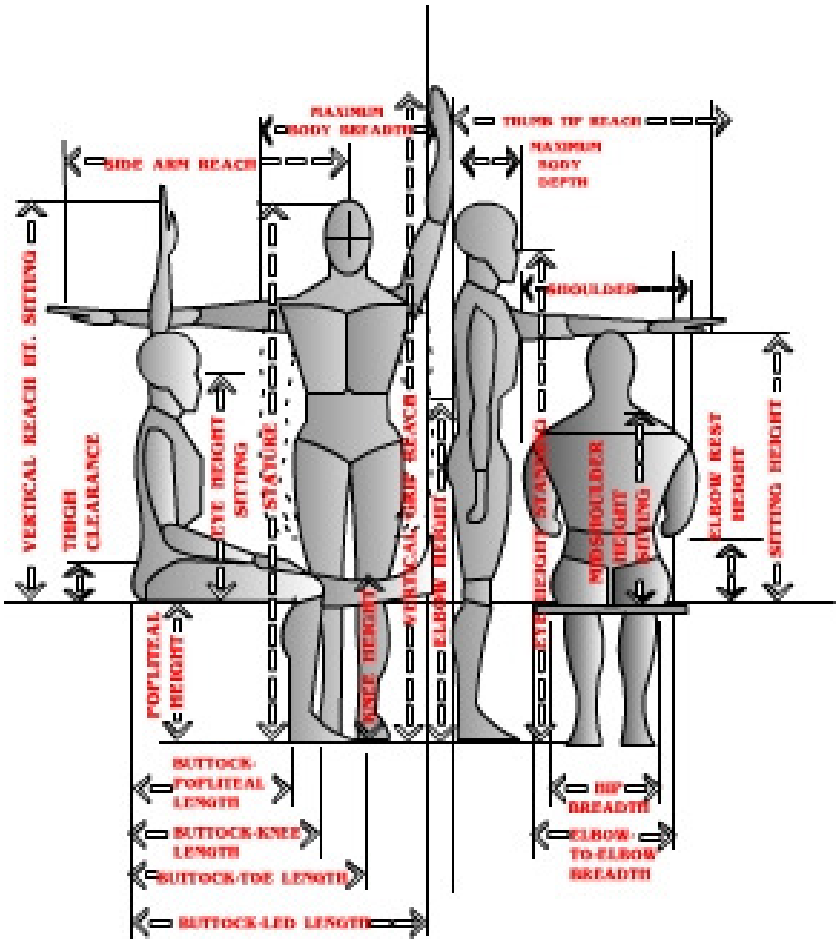
As humans are the major part within design, ergonomics is widely considered during the design process. Both the physical and cognitive ergonomic are essential in the area of design.

Dimension of human figure

Physically humans are being limited by our body which range from a variety of dimension. Understanding the human dimension is the first step in the interior design and product design, such as hand tools and furniture.

Measurement of human activity in spatial design

Within a spatial design area, human activities are the main concern. The dimension on the physical area of human activities is essential in detailed spatial arrangement. While the size of the door, passage, the assessable height of furniture must be well considered from the beginning of the design idea generation, the measurement of human activities affects the dimension of spatial design.



Physical and cognitive ergonomics in design

Physical ergonomics is mostly straight forward in the design process, where the physical dimensioning on human body and human activities are referenced. The area on cognitive ergonomic is in a wider range including the image perception on form, lighting, colour and interaction.

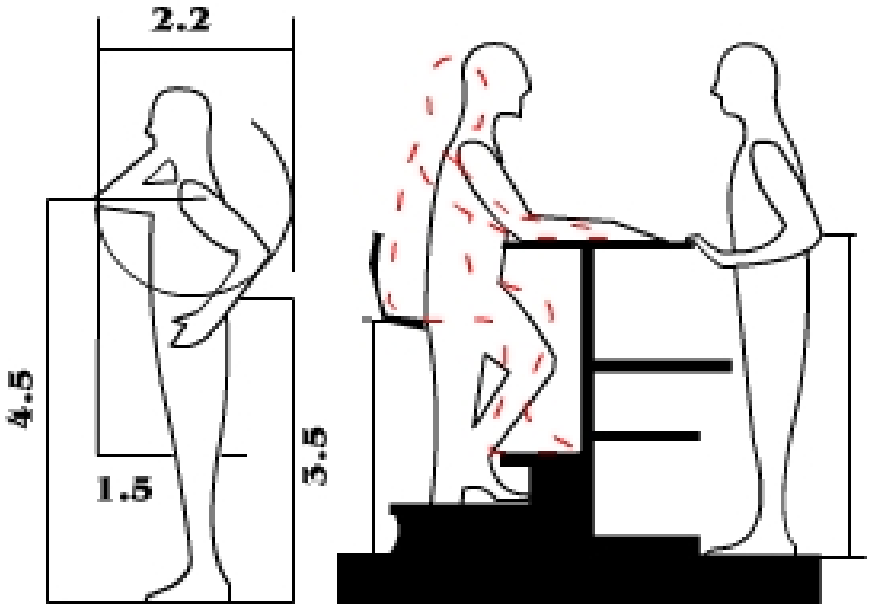
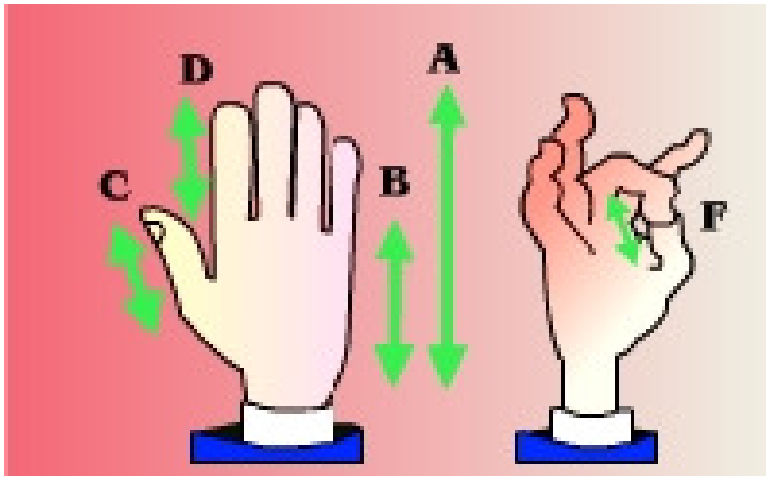


Figure 2.21 Diagram showing the human dimension and the area of activities

Example 1: Ergonomic study on hand tools

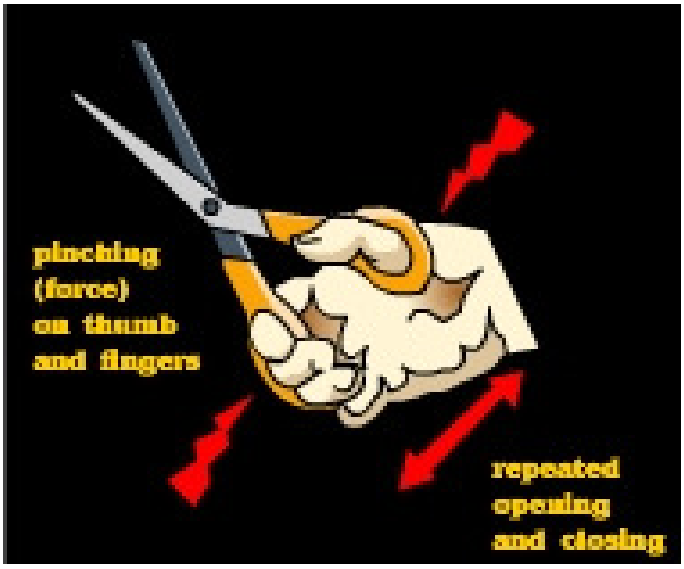
Hand tools of course are handled by our hands. When the comfort, effectiveness and efficiency for the works done with a hand tools are considered, a well ergonomically designed tools will sure be an excellent design.

There were many researches in the study of our hands with dimension. Web based information can also be obtained directly. The following is an example from the Ergonomic Society. The ergonomics4schools is one of the online databases of introducing a general overview to students on the use of ergonomic.
(Reference: http://www.ergonomics4schools.com/lzone/tools.htm)



Anthropometric estimates for British adults aged 19- 65 years(in mm ,from pheasant)			
Dimension	5th %ile	50th %ile	95th %ile
A Hand length	173	189	205
	159	174	189
B Palm length	98	107	116
	89	97	105
C Thumb length	44	51	58
	40	47	53
D Index finger length	64	72	79
	60	67	74
E Hand breadth	78	87	95
	69	76	83
F Maximum grip diameter	43	48	53
	45	52	59
	MALE		
	FEMALE		

Other than knowing the dimensions of our hands, we also have to understand what activities we are handling. Typing, using scissors are totally different actions and requires detailed study on the moment, force, angle, etc.



Example 2 – Human dimension from different countries

Most of the data we can find are done by western professionals. The aim, of course, is to display the dimension of humans, but from a western perspective. Sizes are basically different between eastern and western humans, leading to a failed design with such unsuitable data.

Size China is a project establishing a database of Chinese head and face shapes in a digital format. The database can be directly used in consumer products, such as sunglasses, motorcycles helmets and hygienic face masks.

(Courtesy of SizeChina project - www.SizeChina.com)

2.3.4 Design process and ergonomic

A. Idea generation

Reference on dimension of human bodies is usually used in the beginning of the problem solving process. Reference includes books and research data. For small products concerning particular parts of a human body, measuring the designers' dimension can be a rough guide during the idea generation process.

B. Idea evaluation

By checking the suitability in ergonomics on design ideas, the designer can evaluate a design through comparing different design ideas. As the problem stated in the design brief can be both in physical or cognitive ergonomics, both areas will be considered for the evaluation. Physical ergonomics includes the suitability for and comfort in using the design. Cognitive ergonomics includes the suitability for the use of image perception like the form and colour.

C. Design development

While the design in further development should be with accurate dimensioning and visual specification (e.g. colour and details), ergonomics becomes one of the driving forces towards

the final design. Accurate visualization and mock-up testing have to be made. These include detailed drawing and models of the final design and a series of user tests.

2.3.5 Environmental factors

As the human factors and ergonomics concern more on the human side, environmental factors stress on different perspectives from the environmental itself.

As ergonomics further develops, the well-developed data on the requirements on the environment have also taken place. Environmental factors include all the requirements on the environment for particular human activities. The requirements vary and become specific with different human activities and situations.

Environmental factors include:

(a) Dimension on spatial elements in the architectural structure, such as the dimension of public passage considering the accessibility of disabled user on wheel chair.
(b) Spatial arrangement for particular activity purposes, such as the passage width on exhibition design, the flow of visitors within the exhibition area.
(c) Lighting for particular activity purposes, such as the use of light for both functional and aesthetic purpose. Creating a particular lighting mood for restaurant and providing sufficient lighting for reading in book stores are two extreme cases in the use of lighting.
(d) Ventilation consideration. For indoor interior design, both natural and artificial air flow are essential considerations during the design process. Specific measurement on airflow should be used for specific spatial area with consideration on the number of people.

H I G H L I G H T

Case Study in Spatial Arrangement
(Reference: http://www.designcouncil.org.uk/en/Case-Studies)

Problem:

De Post, the Belgian Post Office, faced increased competition in the European postal market. As there were more and more companies providing postal service, the market was becoming competitive. The old traditional interior style of post office did scare the new generation away.

Response:

UK Design Agency Fitch was appointed to reinvent the post office concept.

Result:

A lively interior design with more space available has been implemented. Its colourful theme has made the post office become more friendly and delightful to visit. It also sets the new standard on the interior of post office.

	
The old design of the De Post of in Belgium, which is mostly very traditional.	The fresh new design of the post office making use of more space and lively design.

2.3.6 Class activities:

Brief:

(a) Divide the class into groups of 6 students

(b) Design 3 handles which suit for the following functions:
- (i) Pull,
- (ii) Push, and
- (iii) Twist

(c) Make use of clay to do the testing on the following:
- (i) Size,
- (ii) Comfort, and
- (iii) Compare the results among groups for discussion.

2.4 PRODUCT STANDARDS

2.4.1 What is a Product Standard

As the modern world develops, we are surrounded with increasing variety of manufactured products. If different manufacturers produce their products according to their own considerations on communication and legal monitoring, there will be problems on the reliability and safety. These problems finally cause harm on the benefits of consumer or even accidents.

If there were no standards, we would soon notice. Standards make an enormous contribution to most aspects of our lives - although very often, that contribution is invisible. When there is an absence of standards, their importance is brought home. For example, as purchasers or users of products, we soon notice when they turn out to be of poor quality, not fitting or compatible with equipment we already have, 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, safety, reliability, efficiency and interchangeability - as well as in providing such benefits at an economical cost.
(Reference: http://www.iso.org/iso/en/aboutiso/introduction/index.html#one)

2.4.2 The benefit of society from international standard

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 increasingly 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.

2.4.3 International and regional standards

There are different product standards in specific areas, some are international and others are for particular counties or economic zone. The following introduces the main product standards we usually face.

A. ISO - International Organization for Standardization

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

ISO is a non-governmental organization: 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 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 organization 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 is not only limited in the product standard, but also extend to other quality issue including the management system. Other than the product-level standards, manufacturers and companies can also obtain ISO certificates reflecting their management quality.

International Standards are numbered, and have a format that contains "ISO nnnnn[:yyyy] Title", where "nnnnn" is the standard number, "yyyy" is the year published, and "Title" describes the subject.

For example:

ISO 9241-6:2000
Ergonomic requirements for office work with visual display terminals (VDTs). Guidance on the work environment
ISO 10005:1995
Quality management. Guidelines for quality plans
ISO 8351-2:1997
Packaging. Method of specification for sacks. Sacks made from thermoplastic flexible film
(Reference: http://www.standardsglossary.com/isoa.htm)

B. GB – Guóbiāo

GB - Guóbiāo (國標) (GB) in the People's Republic of China is the abbreviation of
Guójiā Biāozhǔn (國家標準), meaning the "National Standards"
GB is the standard used in People's Republic of China. GB standards cover many areas, like other national standards, such as ANSI in the United States. Mandatory standards are prefixed "GB".
For example:

GB4706.1-92
General requirement for safety on domestic appliance
GB 2312-80
Code of Chinese graphic character set for information interchange, primary set
(Reference: http://www.etscn.com/standard-cn-gb-hous.htm)

C. CE – European Standard

The letters "**CE**" are the abbreviation of French phrase "**C**onformité **E**uropéene", which literally means "European Conformity". 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". CE Marking on a product indicates to governmental officials that the product may be legally placed on the market in their country.

Example on the directive:

Council Directive 92/59/EEC is the directive on general product safety. Within this directive, several articles will state and define clearly on what standard a product should be in order to be safe.

The logo of the "CE"

D. BS – British Standard

BSI British Standards is the UK's national standards organization 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 Standard covers a wide range of area/ items. It can be the standard on thing as small as a screw to as big as a safety system.

Example on the BS no.
BS EN 15494:2007 is the BS no. for the product safety labels for candles

Pros and Cons. On International and Regional Standard

	Regional Standard	International Standard
Pros	(a) It is a must in some countries as it will be illegal to sell in that market. (b) Less investment, as only one single standard required to be fulfilled.	The profit and markets will increase as it can be sold to more countries.
Cons	Only restricted to a single market, narrowing the profit.	Higher investment cost as the standard from other countries is different. Specifications have to be strengthened to fit into more markets.

H I G H L I G H T

Toys Design - Avoid choking hazards.

The safety standard in toys was set to be really high as there have been many accidents caused by failed toy designs that result in death of children. ISO has already established the standard ISO 8124-1:2000, which is on the safety of toys. This ISO standard is composed of Safety Aspects Related to Mechanical and Physical and other properties. Within these properties, the one that affects the design process is the size of small parts of toys, so as to avoid choking hazards for children below 3 years old.

International toys retailers have a clear statement on the toy safety, promising that the toys they sell have been safe-tested by either the manufacturer or by accredited testing laboratories.

In terms of choking hazards, toys designed for children under 3 must fulfil the following:

(a) Small toys and parts of which must be big enough so that the child cannot swallow the parts (or toys);
(b) Toys must not have any small removable parts that child can take apart; and

(c) Small parts of toys must not be loosened or taken off by the children.

2.4.4 Legislation concern from product manufacturer

There is a strong concern from manufacturers relating to the legislation. Federation of Hong Kong industries is one of the associations in Hong Kong in representing the manufacturers.

The objective of the federation on the legislation issue is to represent business's views and advise the government on policies and legislation which affect business.

There is a representative from the federation in the legislative council.
(Reference: http://www.industryhk.org/english/aboutus/aboutus_obj/aboutus_obj.php)

Protection on consumers through legislation is also an effective way in maintaining the quality of products. There are different ordinances in Hong Kong to safeguard the interests of consumers, and monitor the quality of products.

The following are examples on the ordinance:

(a) Toys and Children's Products Safety Ordinance(Cap. 424)
- An Ordinance to provide for safety standards for children's toys and safety standards for specified chattels used in association with children, and to provide for other powers to enhance the safety of children. Commencement: 1st July, 1993.

(b) Consumer Goods Safety Ordinance (Cap. 456)
- An Ordinance to impose a duty on manufacturers, importers and suppliers of certain consumer goods to ensure that the consumer goods they supply are safe and for incidental purposes. Commencement: 20th Oct, 1995.

2.4.5 Consumer interest

The Hong Kong Consumer Council is an association concerning the consumer interests. It plays an important part in the monitoring quality and safety on product. The Council is committed to enhancing consumer welfare and empowering consumers to protect themselves. Consumers include consumers of goods and services and purchasers, mortgagors and lessees of immovable property. The objectives of the Consumer Council are:

(a) it acts as advocate for consumer interests;
(b) it facilitates constructive discussion and promulgation of pro-consumer policies; and
(c) it sees to empower consumers to help themselves.

This is to be achieved through initiatives directed at the consumer; the private sector; and networking with other stakeholders, such as the media and government.
(Reference: http://www.consumer.org.hk/website/ws_en/profile/mission/mission.html)

2.5 DESIGN EVALUATION

As a design project goes through, we will experience different stages on design. Design is an activity not only requires creative mind, but it also includes logical analysis in realizing and developing the ideas from the creative process. This does not mean that creative thinking is not required at the later development stage. On the contrary, being creative is essential on the whole design process.

2.5.1 Stages of design

There are different stages in a design project where we need checkpoints. A checkpoint is the place where a stage of a design is concluded. Also, we are required to evaluate different design ideas.

Design brief

(a) Research and analysis,
(b) Design idea generation,
(c) Evaluation of design ideas (checkpoint 1),
(d) Design idea development,
(e) Evaluation of design (checkpoint 2),
(f) Finalize design, and
(g) Design visualization

The check point functions as the following:

(a) Landmark on the end of a design stage. For certain stages, like the idea generation, there may not be an exact end until we have the time schedule limitation.
(b) Conclude the last stage with summary of the best solution(s). The solution(s) should be bounded by quantity which is decided in the design brief stage.
(c) Collecting feedback from other parties on the design ideas. In practical terms, this is the stage to present to the clients and review the whole schedule of the project.

2.5.2 Selection of design ideas

When should we stop generating idea?

There will not be any stop for generating idea, but there must be a stop for the idea generation stage. The stage should be stopped when we:

(a) Reach the quantity of ideas stated in the design brief, and they are not repeating in terms of the main concepts;
(b) Reach the end of stage on the time schedule; or
(c) Reach the stage where you think ideas are creative enough.

2.5.3 Evaluation of design ideas

Design ideas are generated mainly based on the design task in the brief, so it is direct in comparing them and find the one which achieve the task most effectively. The elements in the design task can be within one of the following areas:

Area	Criteria	Example
Ergonomics	The idea gains comfort.	Fulfilling the dimension of human body and activities
Users	The idea gains the satisfaction by users.	The visual identity on aesthetic needs of the user.
Process	The idea gains effectiveness and efficiency on the process.	(a) The time required of handling the design is shortened. (b) The design makes the handling of the process easier.
Situation	The idea gains effectiveness and efficiency relating to the situation.	The design considers the storage, reading on the interface buttons.

H I G H L I G H T

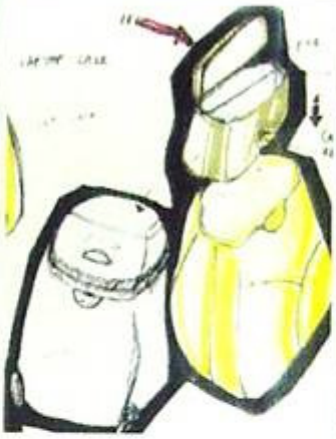
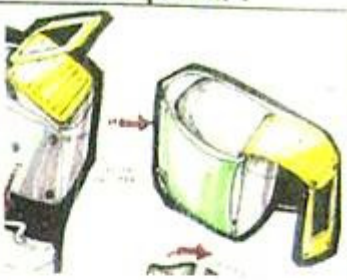
Design Evaluation – Soap maker design

Throughout the design process, there must be a clear design brief, a creative idea generation, and a point where we have too many ideas that we cannot make the final decision.

The example here is a student project on a new machine making soap domestically. The research stage resulted in a list of problems which led to many design ideas. After organizing all little ideas, the project team came up with 10 design proposals.

There were sketches and testing modules made for evaluation, making sure that they all have the potential for further development.

A comparison table was finally made in order to compare all the advantages and disadvantages of the 10 designs, so that the final best can be found.

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

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	

Student project:

Mr. HO Yip Shing, 2001/2002, Higher Diploma in Product Design, 61302, Department of Design, Hong Kong Institute of Vocational Education (Shatin)

2.5.4 Summary on the design ideas

During the evaluation, prediction and estimation are continuously implemented. As the ideas are still preliminary, there will not be accurate information and details. We have to evaluate them according to the potential of the ideas instead of the solid function. Once we face an uncertainty, the idea should be further elaborated before a decision is made.

2.5.5 Development of design ideas

As stated, the design idea is only the preliminary stage with potential. It may or may not be workable or practical for the design problem (the task). The following areas will have to be refined. This process is called design development.

A. Final form

The final form will be decided in fulfilling the ergonomics and form identity. Testing on the form should be made with detailed orthographic drawing and model. Consideration on the different components and how they are jointed must also be considered. Orthographic drawing, sketch drawing and testing model will be used as design tools.

B. Final process

The process should be refined for efficiency and effectiveness. Working model is essential to prove the above on the design. The model should be able to test out the joints and materials. Drawing is also required for the testing on the visual identity and interface. Colour orthographic drawing, process sketch drawing and working model are required as design tools.

C. Materials and production

Consideration on the use of material takes place in this stage. The use of materials will affect the function, form and the process of the design. While considering the materials, the project team has to select a production method. In practice, manufacturers will be involved in providing advice based on cost effectiveness consideration.

D. Evaluation of the developed design

There may be several design ideas being developed into a more refined solution. During the process, ideas can be combined with new inputs. Evaluation is implemented again in selecting the final design.

2.5.6 Refinement of final design

After evaluation of several developed design ideas, one design will be finally selected. Design details are further developed with the final visualization, and the following are included:

A. Detailed design

The designs of every detailed part, which include all the joints, fastenings (e.g. screw) and colour, should be finalized. Accurate parts drawings and assembly drawings (e.g. CAD drawing) and aesthetic specifications are used as the design tools.

B. Material and production method

The materials and production method used should be finalized with clear specification (e.g. CAD specification).

C. Final visualization

Visualization includes 2D and 3D colour rendering with scale drawing, explanation on the usage and function and process on the final design, 3D visualization model or working model in proving the function and aesthetic of the final design.

CHAPTER 3 – DESIGN AND COMMUNICATION

This chapter covers topics on:

3.1 Project Presentation and Report
3.2 Visual Presentation
3.3 Physical, Graphical, Mathematical and Computer Modelling

These topics include learning materials and activities that facilitate your:

(a) understanding of the importance of communicating a design through sketches, CAD rendering, 3D model and animation
(b) ability of communicating a design through sketches, CAD rendering, 3D model and animation
(c) understanding of the possible methods and media of representing design concepts
(d) selection of appropriate methods and media in presenting a design
(e) understanding of the cycle in reiterating a design through presenting the design to the clients

After a design is being accepted by the client, it will be put into production. The process involves heavy communication between groups of people – the designers, the clients and the engineers. Therefore, it is significant that the designer is able to realize her/ his ideas into visual forms. These visual forms should be accurate representations to avoid misunderstanding by any parties.

Modern technologies enhance the presentation of an idea. For instance, a 3D printer realizes a 3D digital design into a physical form. Modern designers have a wider range of presentation media in that perspective. It should be noted, however, that an adept designer does not rely solely on modern technologies. Sketch is often employed as a communication medium when the designer is in the preliminary or developmental stages of a design process. The best visual presentation, as such, should be able to communicate thoroughly the idea of the designer to other parties, regardless of its physical form.

3.1 PROJECT PRESENTATION AND REPORT

It is important that a design can present a project done in appropriate media and methods. There seems to be no fixed rules about the type of presentation a designer should make in order to convey a concept to clients.

The designer must consider, at least, the following factors:

(a) size of the project
(b) constraints of budget, time, materials, technology and culture,
(c) strength of the designer or the design team in presenting concept, and
(d) suitability of the presentation medium to convey the concept.

In short, a designer can present the concept of an animation in still graphics format, one after another. However, an animation is best presented with motion graphics. Needless to say, the motion graphics format costs much more budget and time. Furthermore, the designer or design team may not be competent in presenting the concept in motion graphics. These considerations have to be carefully made before anything is realized.

3.1.1 The presentation board

Having done a model or prototype, sometimes a designer finds it hard to message across if there are different persons looking at your design at different time. It would be very tedious for a designer to go back and forth several times to meet different persons. For example, the engineer or production manager may not be available when you meet the client. It may be worthwhile, therefore, to put down your idea and key points on a presentation board. In that way, different people can review the same idea at different time.

There is no standard format and size for a presentation board. Usually, a designer would use the largest yet handiest size available. Also, there is also a consideration for the size of the board available in the market which usually is of 'A' sizes. Most designers would prefer A2 size presentation board in that perspective.

Some key notes must appear on your presentation board:

(a) The visual of the model or prototype
(b) Smaller visuals to explain different views or usage of a design if any (Caption to explain what is going on)
(c) The heading (Name of the design or the project)
(d) Explanation notes on the concept (Point form usually works well)
(e) Explanation notes on the material or production (Point form usually works well)
(f) Some decorative graphics (Optional and should not be overwhelming)

Figure 3.01

Figure 3.02

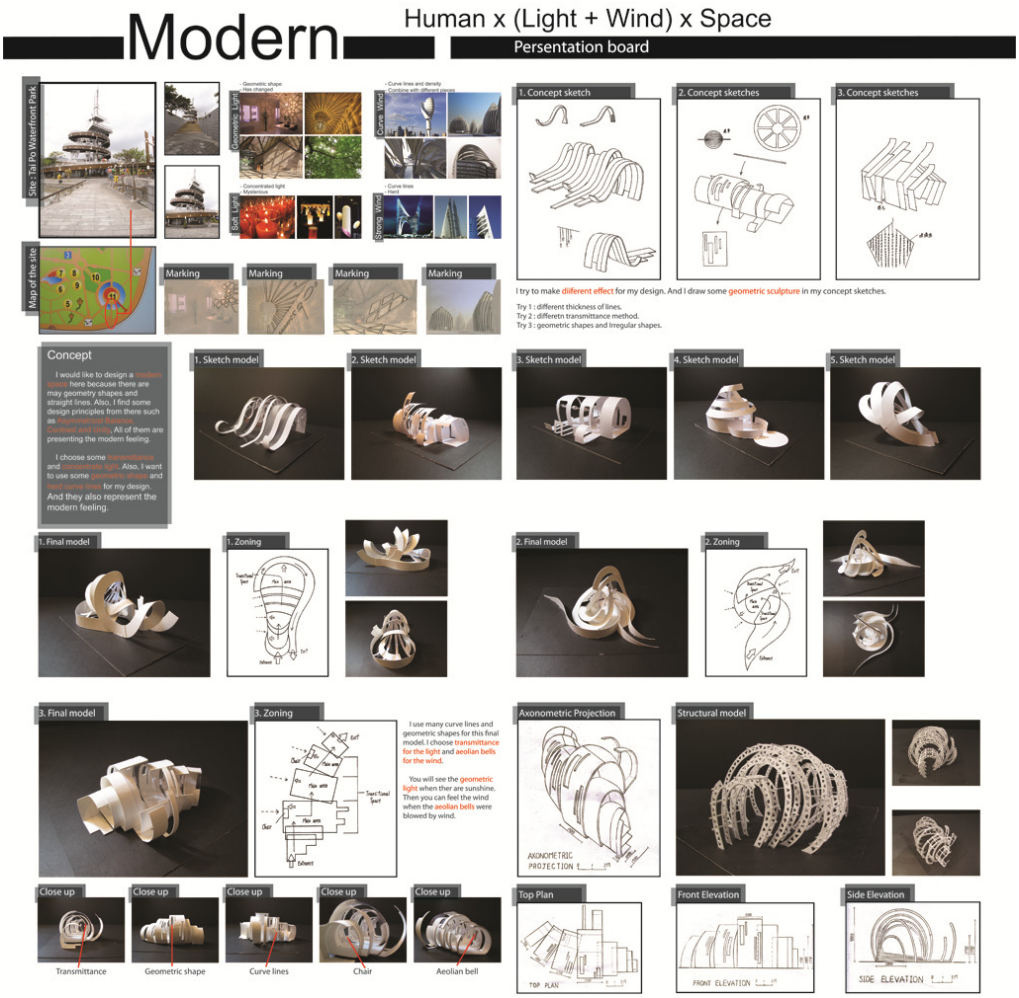


Figure 3.03

Figure 3.01 to 3.03 show some of student work-presentation boards.

3.1.2 Verbal presentation

Most designers begin their verbal presentation with what they want to do. Instead, design should start from a need on the user or client side. Therefore, it will be wise to start by recapitulating the objectives of the project.

It is important that the designer maintains eye-contact during the presentation. Writing down important points on a small notebook or cards helps a lot. The designer should point to relevant areas on the presentation board or model when required. Finally, it will be worthwhile to rehearse before the actual presentation.

H I G H L I G H T

Here is a checklist of what to present:

(a) The objectives of the project
Why is there a need for the design? Do the functions required for the design change? Does the taste of the user change? Is there a need for the change of appearance to better suit the esteem of the user?

(b) The design problem
What have you found out to be the core design problem? The users are kids and their hands aren't big enough for the buttons. The trend of mobile phone is becoming a fashion accessory. The user is asking for a bag that reflects a youthful and active lifestyle.

(c) The design concept
How do you solve the problem? The buttons become smaller with round bevel and softer touch to fit kid's hands. The pattern design on the mobile phone is changeable to suit the everyday fashion need of the user. The colours on the bag become brighter and the form becomes more organic to promote a youthful and active lifestyle.

(d) Material and production
How is the design going to be produced, injection moulding, silkscreen printing, offset printing, vacuum forming, knitting, etc? You will need to show that you have thought out the design thoroughly.

(e) Safety and standard
Are there any safety and standard to match? It will be very clumsy if the designer has not found out these standards beforehand. For example, there are a lot of safety standards for toys exporting to the European market. Be careful, you may lose your credibility in the

project, or worst, lose the job.

(f) Invite feedback

After the presentation, try to invite feedback. It shows that the designer is being objective by doing so. However, don't just ask for the sake of asking. The designer should listen carefully and jot down important points that required action.

3.2 VISUAL PRESENTATION

Presenting a concept visually provides a means of communication among the designers, clients and engineers. Think for a while if a designer communicates verbally only to the others, what would happen? There are many forms of visual presentation and they are explained in the following paragraphs. However, choosing a medium depends on the need rather than the preference of the designers, the clients or the engineers. To exemplify, to present an interior design visually, a designer either uses multiple views of the design in static graphics or computer generated 3D motion graphics. The next consideration after two choices are available will be the budget.

3.2.1 Orthographic drawings

Orthographic drawing is a method of drawing a 3D object at different angles. Normally three views are drawn, namely the front view, the side view and also the plan view.

Advantages using orthographic drawing as a presentation medium:

(a) Show the actual dimension of the design.
(b) Show the parts of the design in their absolute proportion and scale.
(c) All the dimensions and details highly comprehensible by the client or production team, for example, engineers, contractors, models and tool makers.

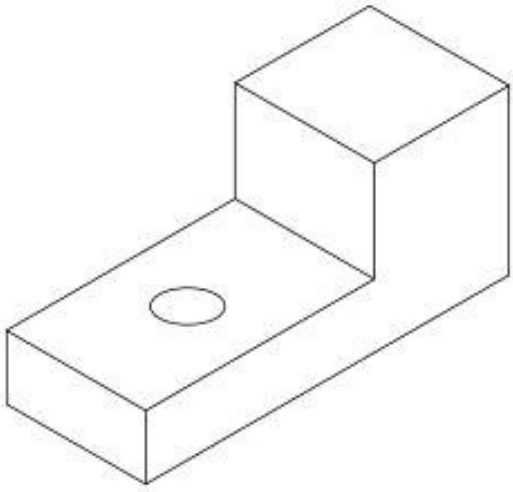


Figure 3.04 'L' shape design block

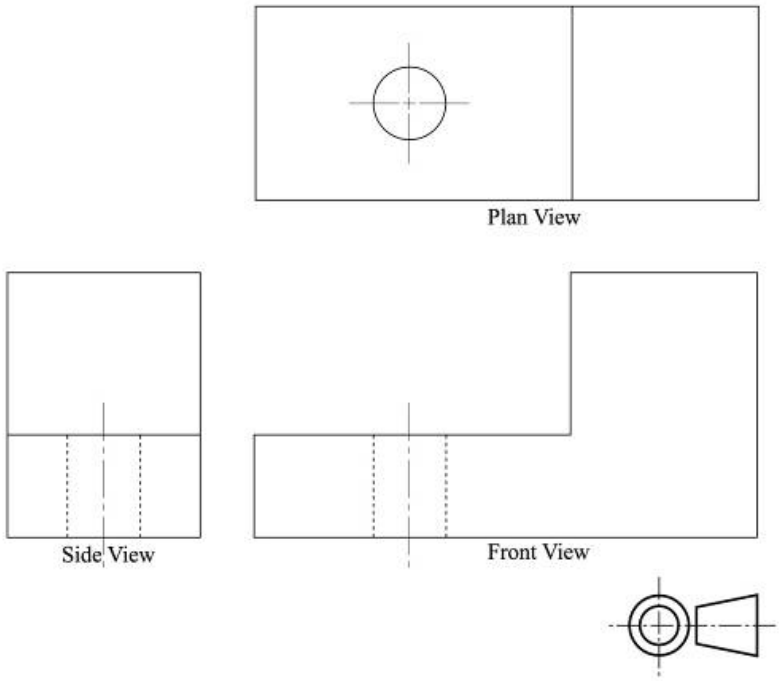


Figure 3.05 Third angle orthographic drawing of 'L' shape design block

The **third angle orthographic drawing** above shows the front, side and plan views of 'L' shape design block. The top view is drawn directly above the front view. The side view has been drawn next to the front view.

This style of orthographic drawing is called *third angle orthographic drawing*. This way of orthographic drawing is used as the standard for designers. It is also easier to draw and understand.

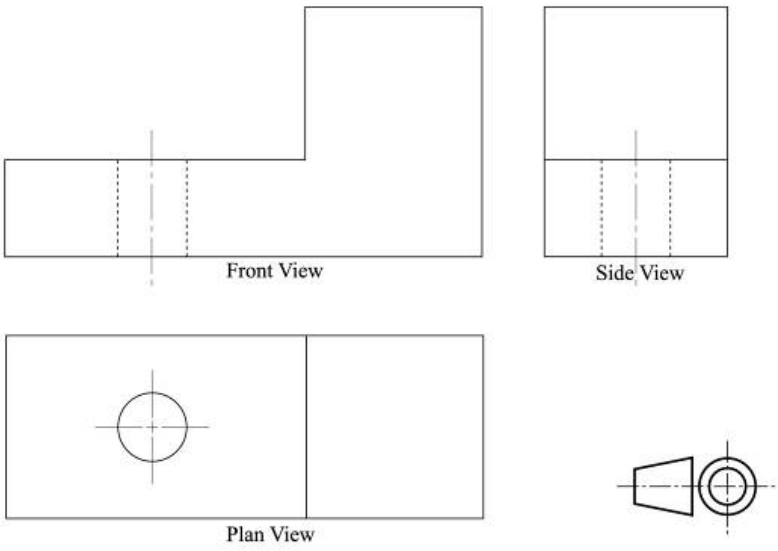


Figure 3.06 First angle orthographic drawing of 'L' shape design block

Note the position of the plan and side views in this **first angle orthographic drawing** of the same 'L' shape design block. First angle orthographic drawing is less popular than third angle orthographic drawing.

3.2.2 Isometric drawing

There are many different types of 3D drawings. One fairly simple way to get started drawing in 3D is to try an *isometric drawing*. There are some basic lines in an isometric drawing, *the vertical* and *the left* and *right line* measured at 30˚ to the horizontal. All the vertical and horizontal lines should fit into this system. Likewise, the circle, tilted lines in a design should become distorted according to the 30˚ rule.

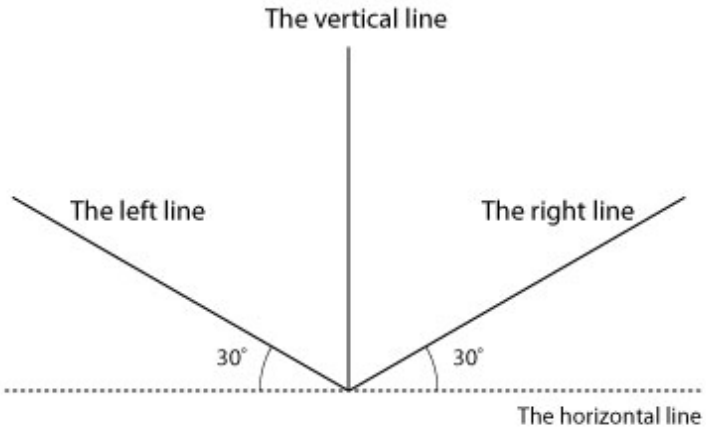


Figure 3.07 The isometric structure

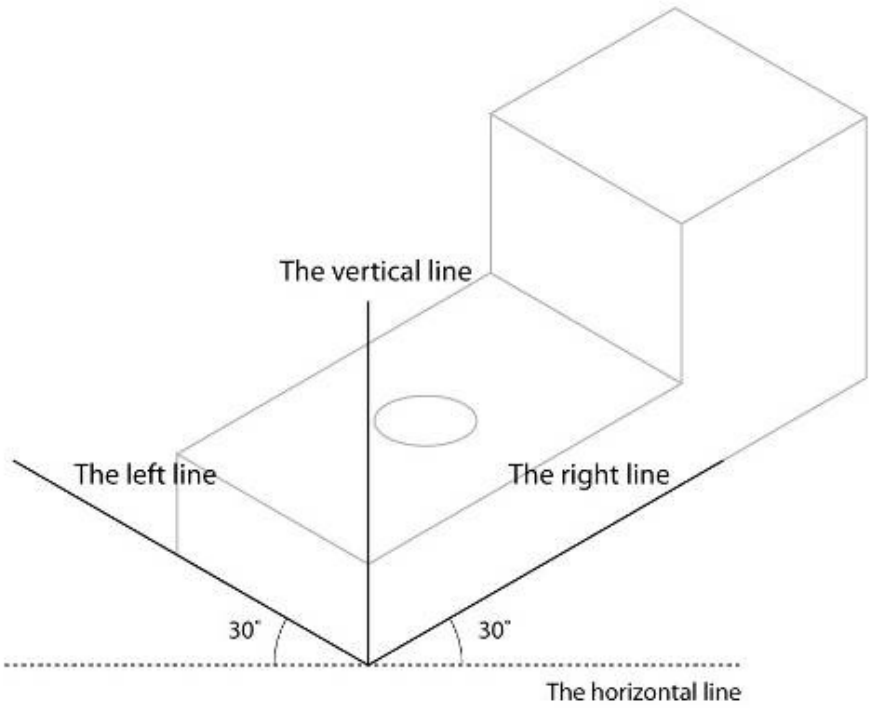


Figure 3.08 'L' shape design block being fitted into the isometric structure

3.2.3 Hand sketch

There are numerous hand sketch media to choose from when the designer wants to present an idea, such as pastel, poster colour, gouache, airbrush, ink, acrylic, etc. However, the most popular media are pencils, colour pencils, felt pens, watercolour and markers. These media are handy and easy to use.

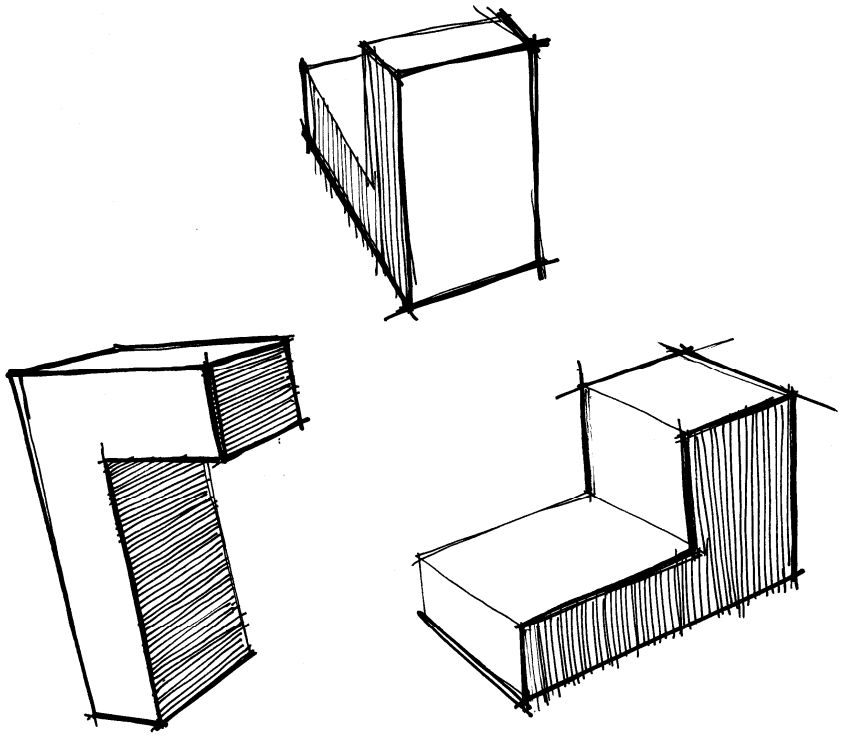


Figure 3.09 Felt pen sketches of 'L' shape design block.

Figure 3.10 A marker rendering of an architectural exterior

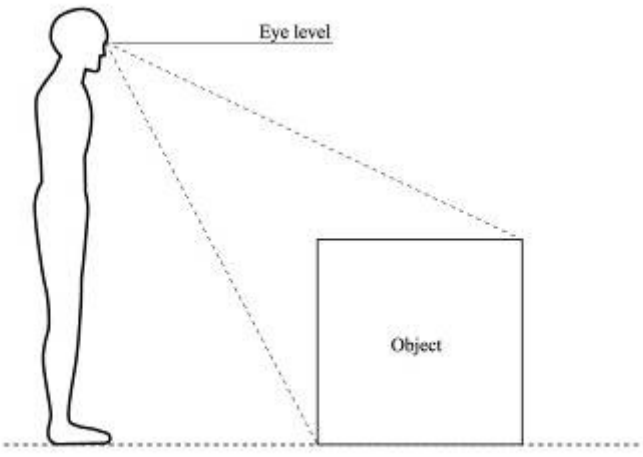
Figure 3.11 A marker rendering of a racing car

Figure 3.12 A marker rendering of a book cover design

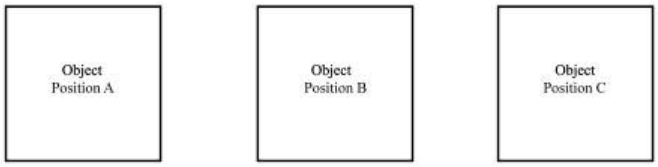
H I G H L I G H T
A. Perspective When a designer wants to present a 3D design, perspective must be taken into consideration to give an impression of space and dimension. The following explains how perspective can be achieved:


Photos of buildings


Lines indicating the perspectives

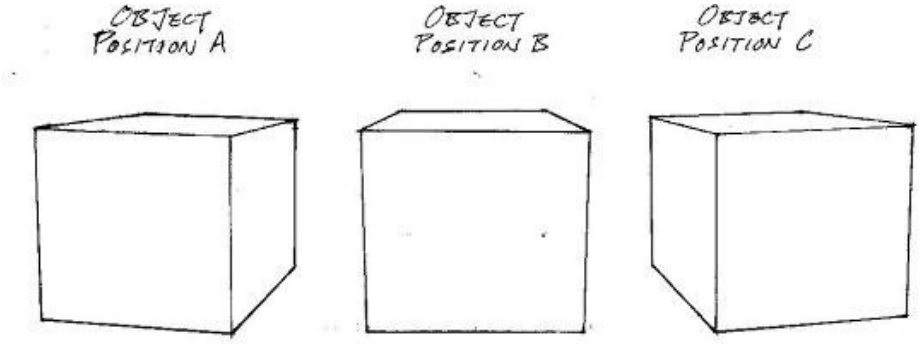


Front View



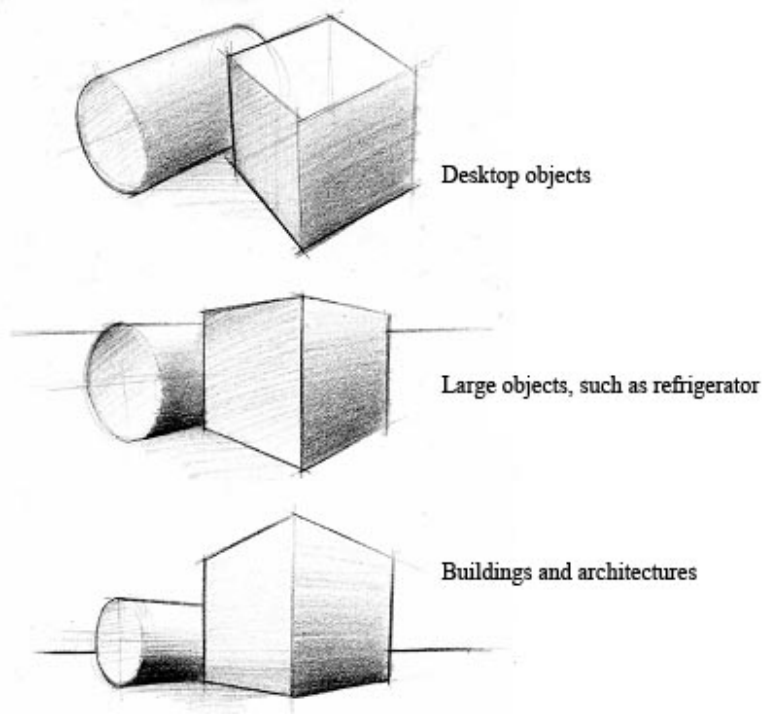
Plan View

Assuming that the man in the above diagram is viewing the same object, in different position as indicated in the top view.



The man will see the object in different perspective as indicated above.

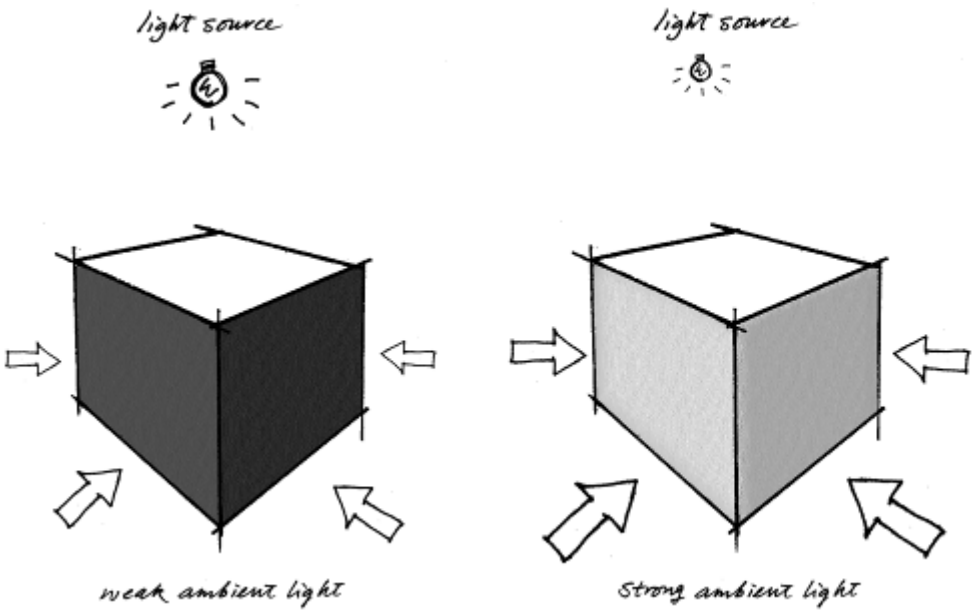
Greater details on achieving perspective drawings will be discussed in the module Visualization and CAD Modelling.



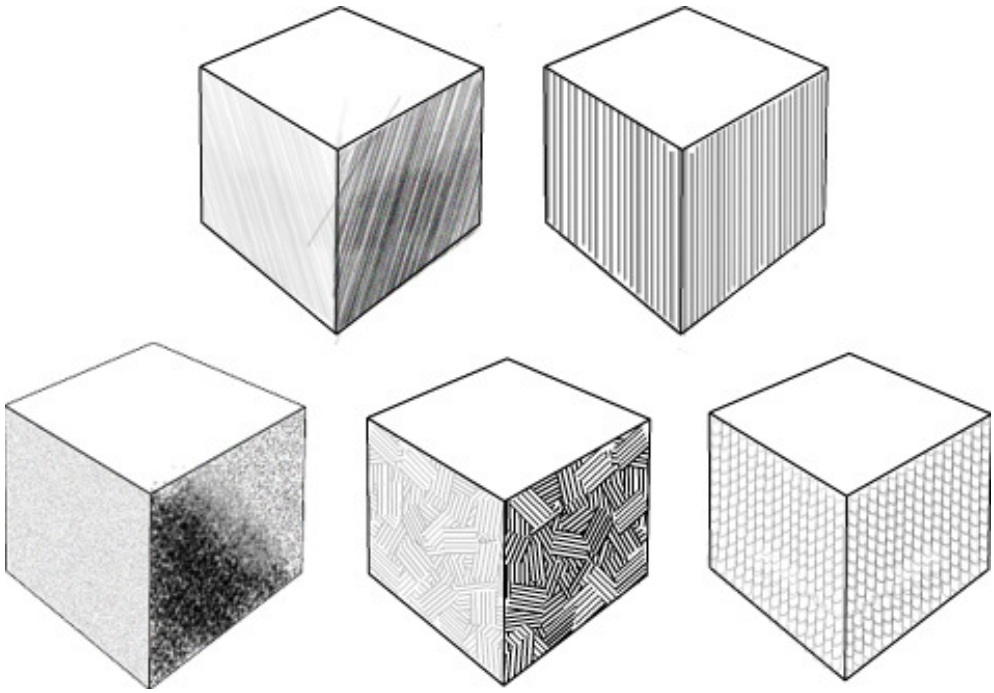
B. Shading

To further enhance the spatial and dimensional qualities, the designer can introduce shading into the sketch.

The tonality of the shade also suggests the intensity of source and ambient light.



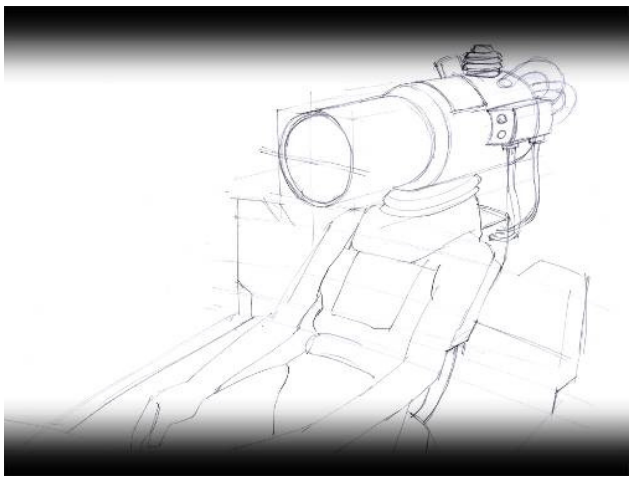
Different methods of shading using pencil. Note that the designer is consistent in using the same style of shading within an object.



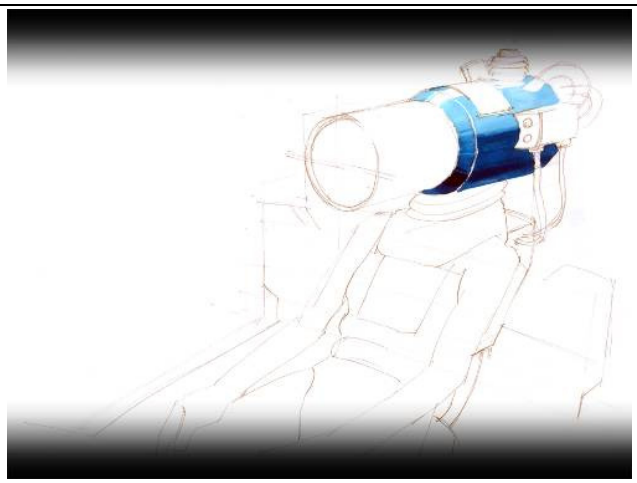
H I G H L I G H T

C. Drawing a robot with mixed media (Marker, pencil, colour pencil and pastel)

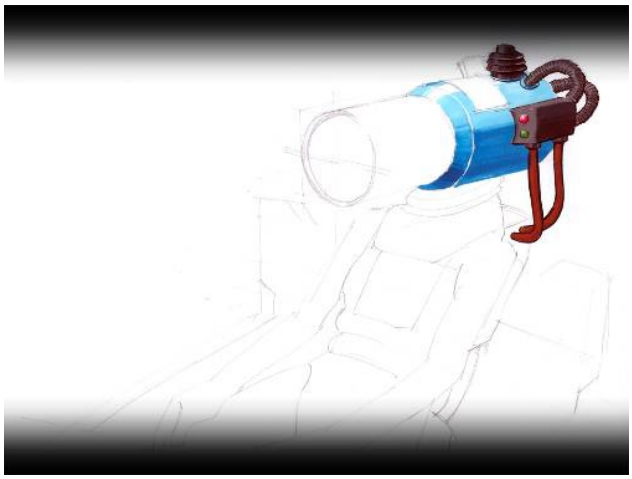
Line drawing is a very important foundation for your rendering. Therefore, it should be accurate and include as many detailed as possible.



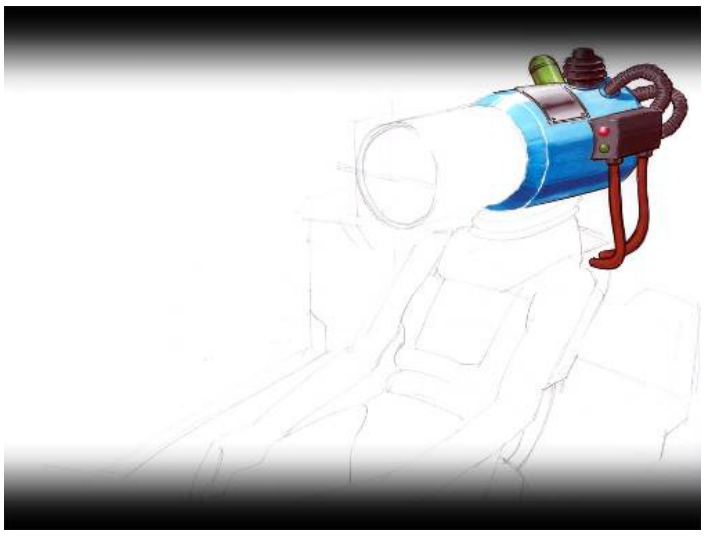
Most designers prefer to put the light source on the top left hand corner, but you should be critical in choosing light source direction as they also create a 'mood'.



Select the larger areas to fill in colour, working gradually to smaller areas.



Note that different materials possess different surface qualities. If you are not sure, find a reference object and observe its surface quality. For instance, aluminium can gives metallic quality.



Silvery metals are highly reflective. Use pastel to create the reflections of sky (blue) and land

(brown) and leave a large white area in between.

Using fine-tip felt pen to depict the shape will give sharper definition to the drawing.

The background is also important in giving depth to the drawing.

Pale colours are used for the shadows of the arm and arm braces because these parts are of lesser significance.

Finally, touch up the highlights on the lens, the type on the labels and besides the red and green lamps.

3.3 PHYSICAL, GRAPHICAL, MATHEMATICAL AND COMPUTER MODELLING

3.3.1 Physical model

Models are a highly communicative medium. At a certain point in the design process, the designer is required to present the idea using models.

Advantages of using models as a presentation medium:

(a) The designer can work out detailed parts of a design in 3D.
(b) Models eradicates any misunderstandings in 2D drawing.
(c) Clients can see a design in multiple views.
(d) Clients can get a better impression of the scale, proportion, material, texture, colour, form and moving mechanism (if any) of the final design.
(e) The production team can have a better impression of the final design, and rectifies possible production flaw and minimizing cost.

A. Paper and cardboard model

Paper and cardboard are the handiest materials a designer can use. They can be easily cut and glued together to create new forms. They come in a variety of colour, texture and thickness. The drawback of using paper is its inability to flex and create organic 3D shape.

Figure 3.13 Student works - using paper as the modelling material in a body decoration project

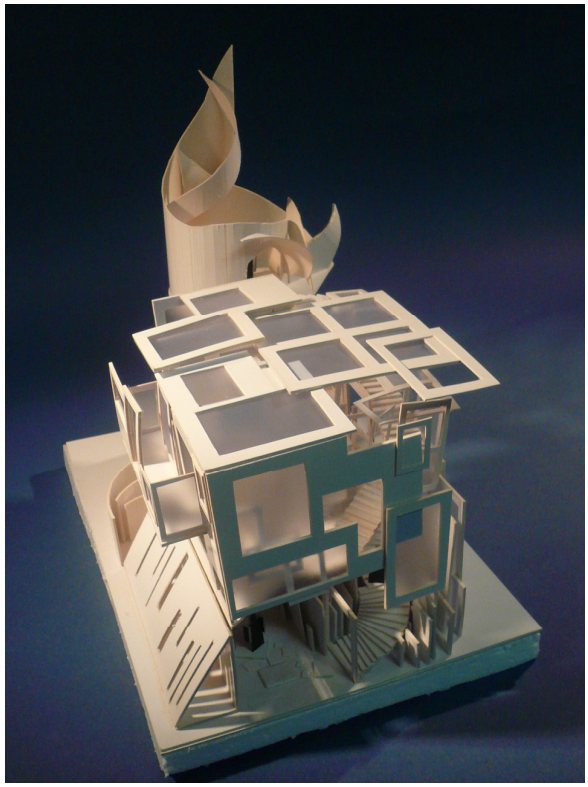


Figure 3.14 Student work - using paper to build a structure

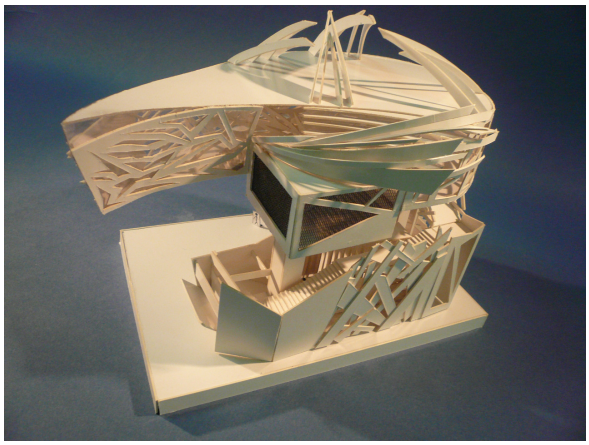


Figure 3.15 Student work - using cardboards as the modelling material

B. Foam model

Constructing a foam model is a good way to show your clients the development process of a product. The foam represents an idea rather than a finished product. Designers like to show their clients rough foam models a few times during development before going onto the finished product prototypes.

Foam is a low-resistance material and easily sculpted using carving tools such as cutter. It is ideal for quick form studies and concept models.

Figure 3.16 Foam boards come in several colours, sizes and thicknesses

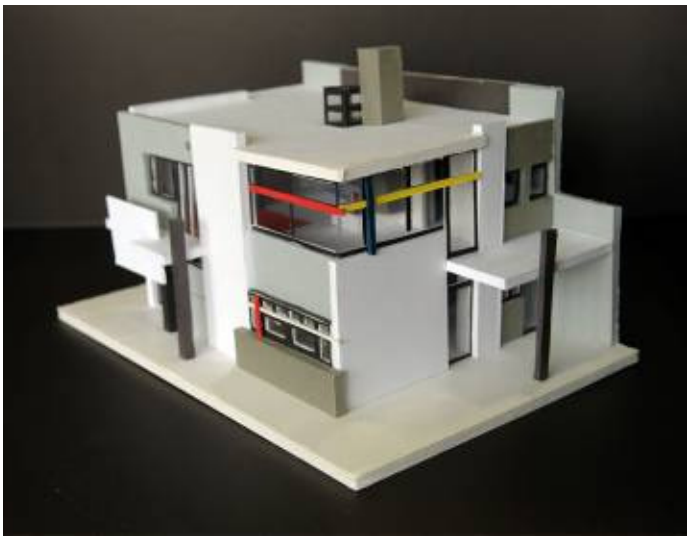


Figure 3.17 A foam model

C. Material for plastic model

Plastic is a popular material in the modelling making industry. It is a material which can stimulate as the final manufactured piece. The plastic material used in model is usually thermoplastic. The most common plastic materials are polystyrene, acrylic and polyurethane. These materials are used for modelling purposes but not manufacturing.

Figure 3.18 Plastic model of a fighter jet

Figure 3.19 Plastic model of baby walker

i.) Plastic material - Polystyrene (PS) sheet

Polystyrene sheets are in a standard mass production form with different thickness. Sheet form plastic is the most widely used modelling material for 3D design. Polystyrene sheets have the following advantages for modelling:

(a) It can be formed under relatively low temperature. It can be deformed even under the hot air from the domestic hair dryer.
(b) It has relatively low stress and strength resistance, making it easy to be cut, sanded and filed. Simple hand tools can handle PS and be very efficient in making models.
(c) It can be joined with glue easily. Industrial and modelling thinner can be used as glue during modelling.
(d) It can be finished with spray paint easily. PS can absorb paint with high finishing effect, which is very effective in stimulating different colour and finishing in 3D design.

ii.) Plastic material - Acrylic

Acrylic is usually in sheet form and specially used for transparent effect. Acrylic is also widely used in the modelling industry for its higher strength property (comparing with PS sheet). Also, it can stand supporting for working test model. Acrylic usually appears in a transparent sheet as well as solid high gloss colour. It also has the same advantages as the PS sheet, but with a higher selling price.

iii.) Plastic material - Polyurethane (PU)

PU is a thermosetting plastic in a liquid form and will set into solid once it mixed with catalysts. It usually produces with moulding method. It is a convenient material especially for free form design. Once it was out of the mould, the basic form was produced and ready for painting with minimum refinement required. PU is an expensive material which is mainly

used for very detailed and free form. PU is widely used in the figure modelling as it can produce extremely fine details.

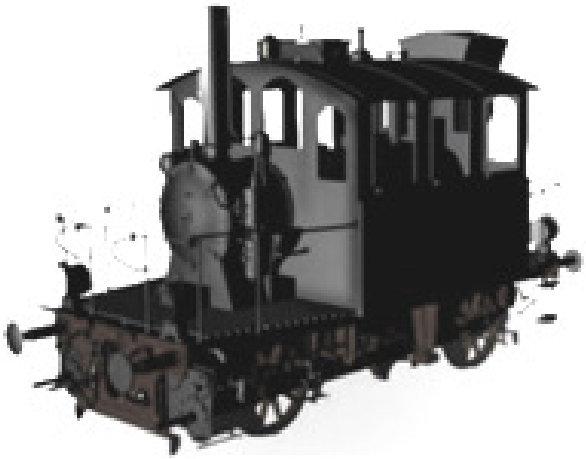


Figure 3.20 PU model

D. Production Method for Plastic Model

i.) Plastic production method – fabrication

With cutting, bending, gluing and fastening, plastic sheets can produce fine models. It is mostly used in the modelling industry as it is the cheapest production method. Even low-tech workshop can handle the whole process.

ii.) Plastic production method - Vacuum forming

With a vacuum forming machine, a hollow form can be made. With an original mould made and plastic sheet softened by heater element in the machine, the plastic sheet will form a skin layer on top of the mould and finally cool down to be an individual hollow form. This is a low cost production method not only for modelling, but also for manufacturing for large scale.

Figure 3.21 Vacuum formed casing

iii.) Plastic production method – moulding

Moulding is a process that generally works with liquid material like PU and plaster. The mould is usually made with two pieces of materials (which can be plaster or silicone). The hollow part in the mould can be filled with a liquid material. The material will be taken out once hardened. Moulding usually works on free form and complicated defined modelling. The cost of moulding method ranges from very high to low, depending on the fineness you required.

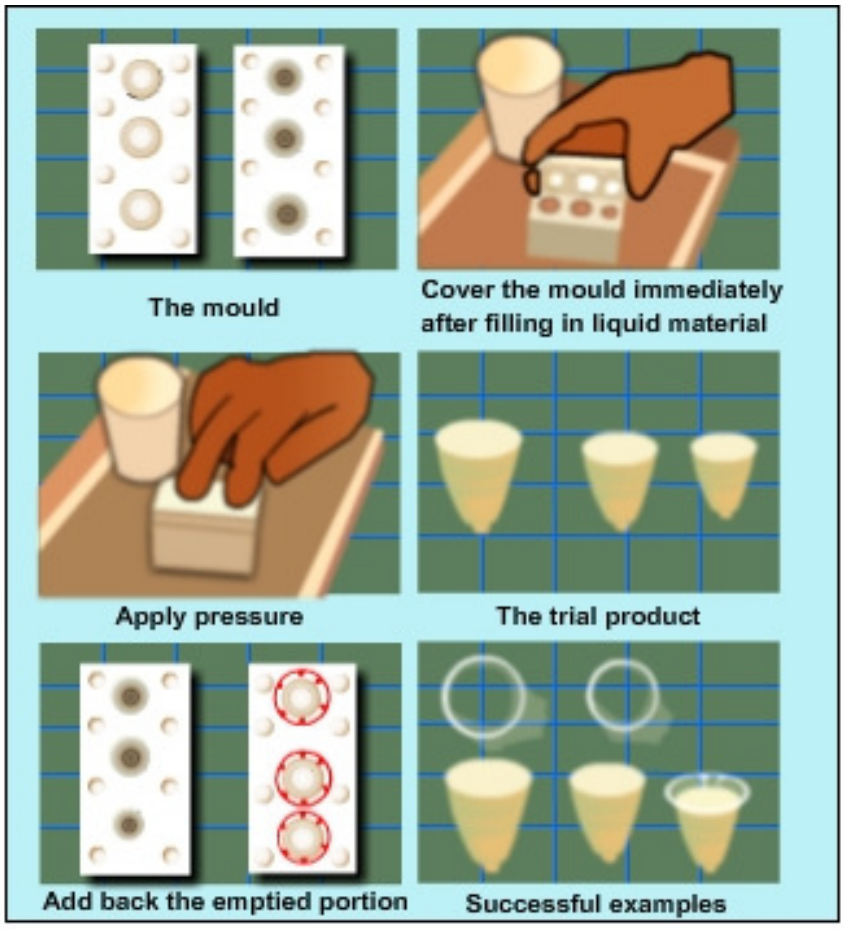


Figure 3.22 The moulding process

E. Mix Media

Not all models start from scrap. A designer may make use of existing parts to build a model. It depends solely on the designer's intuition, and there is really no limitation on the materials, which can be yarn, egg shell, soft drink bottle, nut and bolt, CD, newsprint, ribbon, fork, spoon, metal wire, ping pong ball, light bulb, used package, etc.

Figure 3.23 Student works - figures made with prefabricated materials, soft drink bottle, wool, threads, cotton (as stuffing materials), metal wires and cloth.

F. Rapid prototyping

i.) Stereolithography

A common method for producing 3D models with high accuracy and good surface finish is called stereolithography. It transforms data in computer files generated with software, such as Rhino3D, into 3D models. The machine that is capable of producing these parts is called Stereolithography Apparatus (SLA).

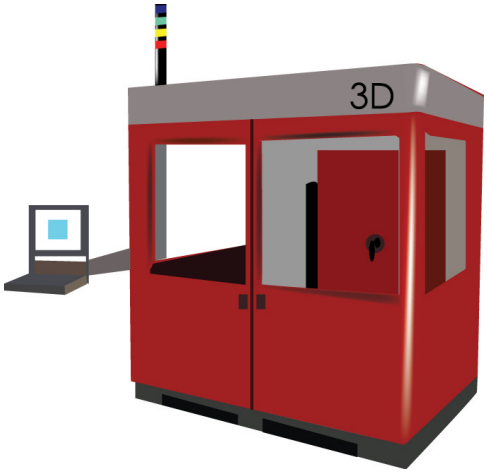


Figure 3.24 A stereolithography system

Stereolithography utilizes a process called the additive fabrication process to build 3D models. A liquid, namely, UV-curable photopolymer (resin), is solidified when a UV laser strikes on it, building the part layer by layer. The UV-curable photopolymer, originally used for the printing and packaging, solidifies swiftly wherever the laser beam hits the surface of the liquid. The laser beam traces the cross-section pattern on the surface of the liquid resin on each layer.

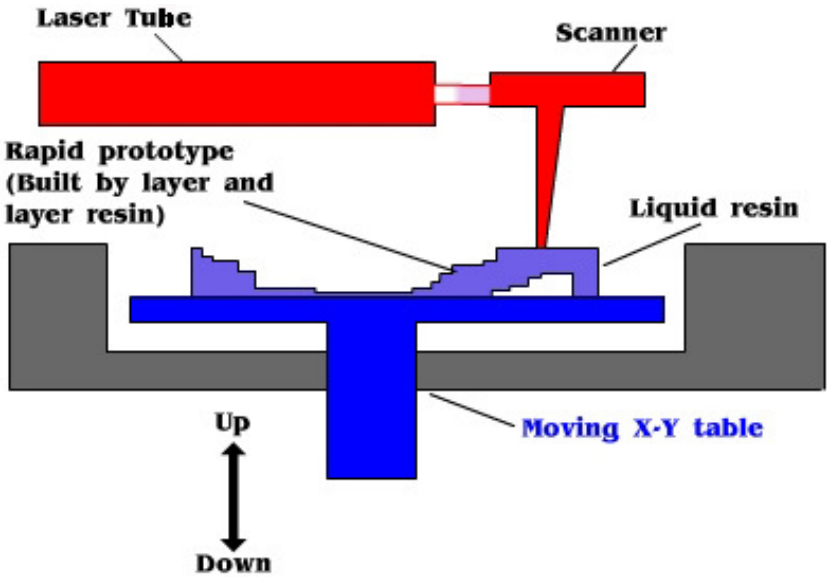


Figure 3.25 Stereolithography (STL) Technology

ii.) 3D Printing

Another method for building 3D model is called 3D printing. It is a kind of rapid prototyping technology. Like stereolithography, it builds a model by layering and connecting successive cross sections of the material. The machine that is used for building 3D models is, thus, called the 3D printer. It is faster and less expensive than the SLA and easier to use than other additive fabrication technologies.

A 3D printer consists of an inkjet printing system. Materials used by 3D printers are plaster, corn starch, or resins. Layers of a fine powder are adhered together by emitting an adhesive from the inkjet print-head, forming the shape of each cross-section as described by a CAD file. This technology also enables printing of full colour prototypes. In this sense, 3D printing is cost effective and easy to use, making it suitable for visualizing during the conceptual stages of design. Most importantly, it uses non-toxic material versus that used by stereolithography.

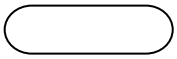
Figure 2.26 Models built by 3D printer

3.3.2 Graphical presentation

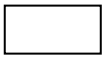
Flow chart

A flow chart displays the stages or operations in a process, such as designing or manufacturing a product graphically. There are standard symbols representing each stage in the process. A flow line connects the symbols and an arrow can be use to depict the sequence of the stages. It is a good practice to start the flow chart at the top or left hand side of a page.

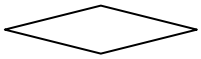
A main set of processing symbols are shown below. The booklets BS 4508 and PP8888/1 published by the British Standards Institute contain a recommended procedure for flow charting.



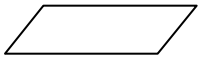
Preparation
Stands for the beginning, modification or end of a process



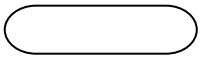
Process
Used to show part of a general process



Decision
Requires decision that may lead to other paths



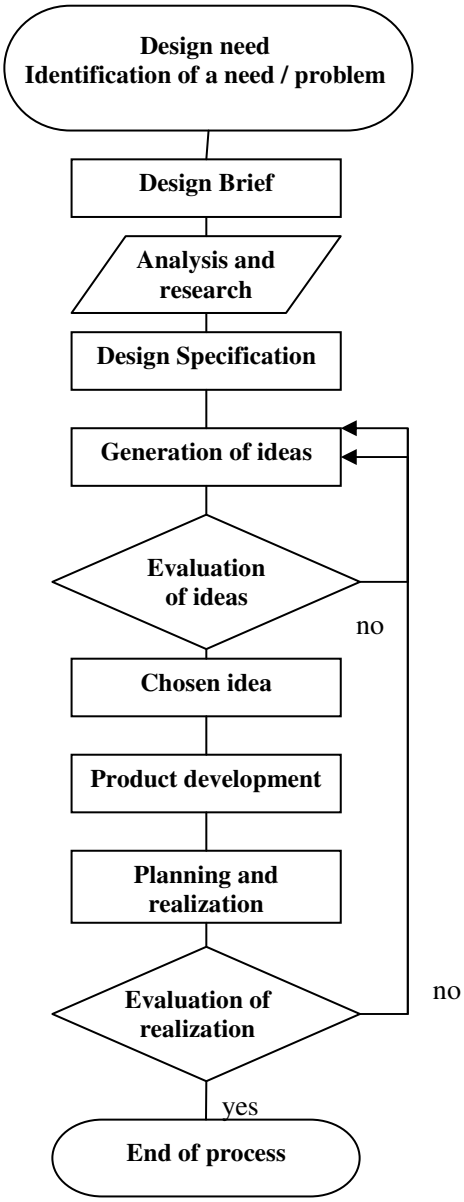
Input / Output
Indicates addition or deletion from the process



Terminal / Interrupt
Delay, stop or interruption in a process

S T O P A N D T H I N K

Using flow chart to show sequences
Showing a design process in a flow chart



3.3.3 Algorithmic Equation

Numeric figures for results of algorithmic equations can be easily and conveniently displayed in spreadsheet software in computers. Algorithmic equations can be input in the cells of a spreadsheet and results are generated automatically. Spreadsheet is best used for displaying results in algorithmic equations, such as product performance, material consumption, product sales, etc.

B3 =SUM(A3*A3*3.14)

	A	B
1	Area of a circle	
2	Radius (cm)	Area (cm^2)
3	2	12.56
4	2.5	19.63
5	3	28.26
6	3.5	38.47
7	4	50.24
8	4.5	63.59
9	5	78.50
10	5.5	94.99
11	6	113.04
12	6.5	132.67
13	7	153.86
14	7.5	176.63

Figure 3.27 A typical spreadsheet on computer.

Note that cell B3 has an equation attached to it which equals to the area of a circle with radius on cell A3. The equation is displayed in the box next to *fx*. Employing the same formula, the areas of circles with different radius on the column A are conveniently displayed on the corresponding cells in column B.

3.3.4 Computer-aided Design

A. Still graphics

Computer-aided Design (CAD) is the use of a wide range of computer-based tools that assist engineers, architects and other design professionals in their design activities. This includes the use of specialized software and hardware in both 2D and 3D designs.

Advantages of using CAD as a presentation medium:

(a) Designers can easily amend a design without drawing up the design again from ground zero.
(b) A wide range of output, including 2D output on paper, 3D printing and laser-cutting
(c) CAD drawings can often be directly processed by output machines.
(d) The design can often be presented in different 3D views easily. Where necessary, the designer can render an animation to help the client understand the product.

Figure 3.28 A set of rendering created using CAD for 'L' shape design block.

Note the numerous possibilities in lighting and viewing angle.

Figure 3.29 Student work created by 3D CAD software.

Note the high degree of resemblance in material, light and shadow and surface texture.

Figure 3.30 Student work created by 3D CAD software

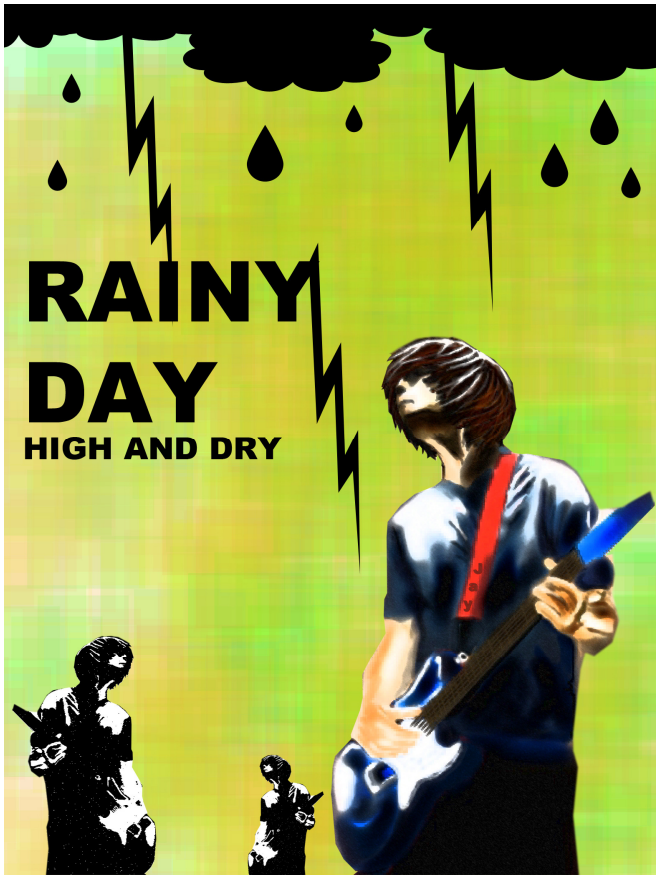


Figure 3.31 Student work created by 2D CAD raster software.

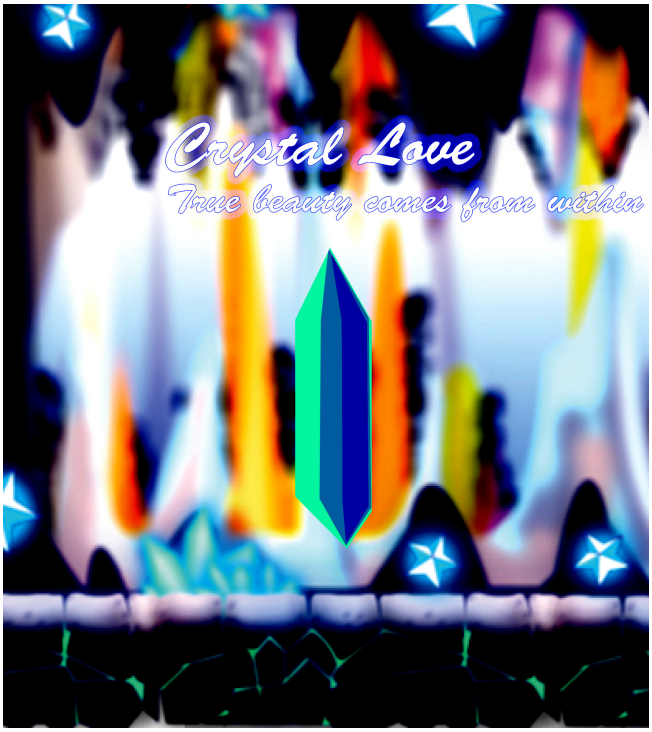


Figure 3.32 Student work created by 2D CAD raster software.

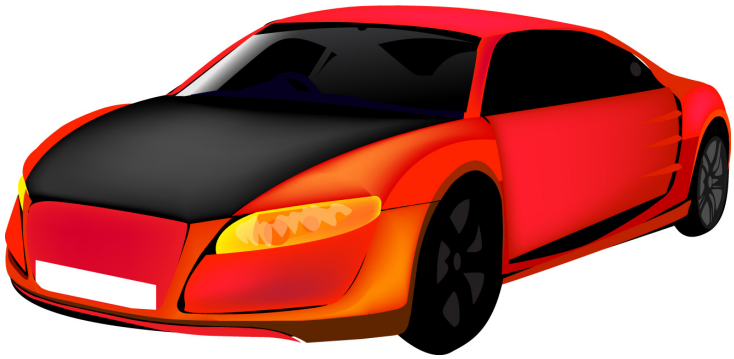


Figure 3.33 Student work created by 2D CAD vector software.

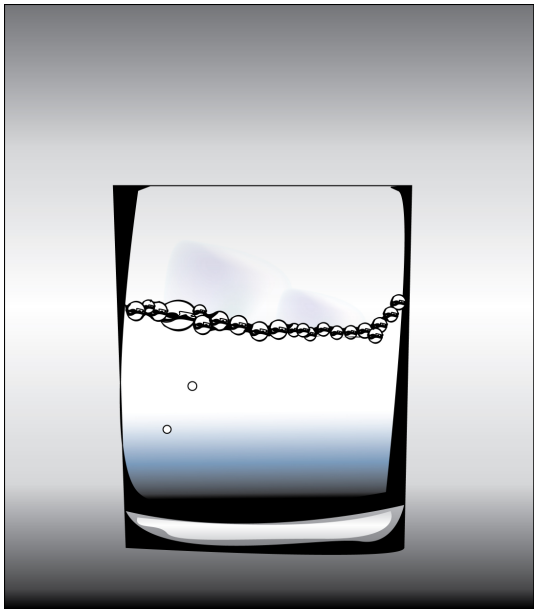


Figure 3.34 Student work created by 2D CAD vector software.

B. Animation

It is often difficult to communicate a design concept verbally, especially when it comes to design with complex modes of use, movement or spatial views, utilizing animations effectively solves this problem.

Normally, 3D or *walkthrough*[3] animation best describes the scenario. There are specialized software package[4] for 3D and walkthrough animation.

[3] A walkthrough animation is a simulation of the view of an audience walking through or flying through a space, giving the viewer an impression of the actual spatial design.

[4] Rhino and 3D Studio Max are examples of 3D design software and AutoCAD is example of spatial design software.

THEME-BASED LEARNING

Theme 1 – Case Study of Chair Design

Case Study 1 – LosPalurdos Chair Design

Lines and shapes matter in a designed item

The conception of designed items can range from a small and simple item like a hair clip to a big and complex item like a building. Everyday we walk by or use these items without querying the aesthetics of its design. These designs often possess very different characteristics and appeal to different groups of users.

(a) Swedish architect Per Fahring's LosPalurdos chair provokes speed and motion. Its large void volume compares to that of the big wheel of a racing cars.
(b) The aero-dynamic lines resemble a race car design and reinforce the feeling of speed.
(c) The slightly forward slanted design of the shape also gives a sense of power and forward-thrust.

Swedish architect Per Fahring's LosPalurdos chair

A Ferrari Enzo race car

Another set of bench design by Per Fahring.

What do you realize in it? Spin wheel? Boomerang? Or an airplane propeller? Motion is being translated into the design of lines and forms.

Case study 2 – De La Warr Pavilion Chair Design

Background information

BarberOsgerby, a group formed by two extremely talented British designers, designed a chair for the De La Warr Pavilion. Launched only one and a half month, the chair has already been selected as one of the permanent collection of the V&A Museum. The De La Warr Pavilion was the UK's first public building built in the Modernist style. Standing by seaside on South East England, it is designed by architects Erich Mendelsohn and Serge Chermayeff in 1935.

The architectural design of the De La Warr Pavilion.

Design of the De La Warr Chair

At a first glance, the chair is really simple. However, when you look closely at the De La Warr Pavilion and the BarberOsgerby's chair, you will discover a lot of suggestions between the two. There is not any new material or extravagant lines in the design. BarberOsgerby just

put together two very different shapes, the flat back piece going all the way around with the skid leg and the round thin tube in the front.

BarberOsgerby's De La Warr chair

Edward and Jay of the BarberOsgersby

The designers claim the design to be 'odd' without being placed in the context of the De La Warr Pavilion. There are regularly holes punched out of the polystyrene on the seat and the back which really create the dynamics of the design. What is amazing about the design is that the designers have done minimum work to get a lot.

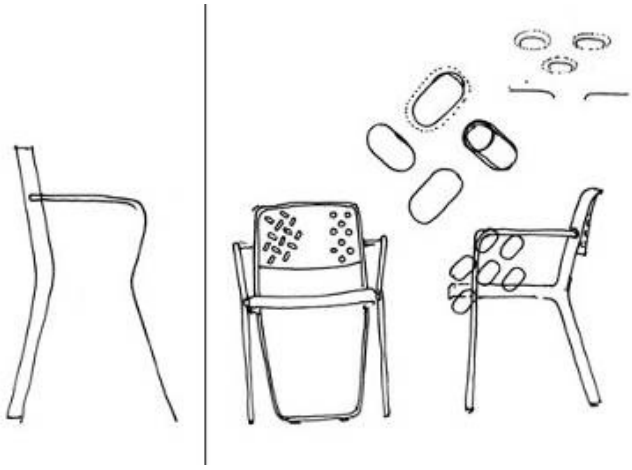
The plywood version breaks easily. The designer

uses aluminium and polystyrene instead.

First, the material was originally plywood which actually feels formal and conventional. They changed it to polystyrene, giving it a contemporary touch. Second, the combination of thin tube, flat pressed aluminium legs and hand rails is really about the line and form of the De La Warr Pavilion.

On closer examination, you will find that there are a lot of similarities between the chair and architectural design. The Pavilion is made up of simple geometric blocks, a tubular structure protruding at the end of a low-laying but panoramic shape. Handrail is one of the distinguished features of the Pavilion. Another feature is the rectangular 'holes' on the building. They are the void areas of the handrails and windows.

Holes on the seat and back.



Sketch by the designers suggests that these holes have been studied in a more 'rectangular' shape which matches the De La Warr Pavilion's void areas.

An important piece of work in the history of design, as you can see, does not have to be ground breaking in terms of material or line and form design. Instead, an adept designer will take the elements of line and form from the context and feed them into the design, as you might have probably understand from this example.

Learning Task: Design a chair for your home

Designers are extremely cautious in using lines and shapes in appealing to a target group of users. A meaning is often expressed through the design itself. The previous examples show how a designer utilizes lines and shapes as a secret salesman when promoting a design.

(a) Find an object with distinct features: fish, flower, plane, bicycle or even human.
(b) Study the distinctive lines or shapes the object bears. It is best to use sketches to study these features closely.
(c) Clone these features on the chair you have chosen. You can choose to be concrete or abstract. Whichever way, the main point is to be able to clone these lines or shapes onto the chair.

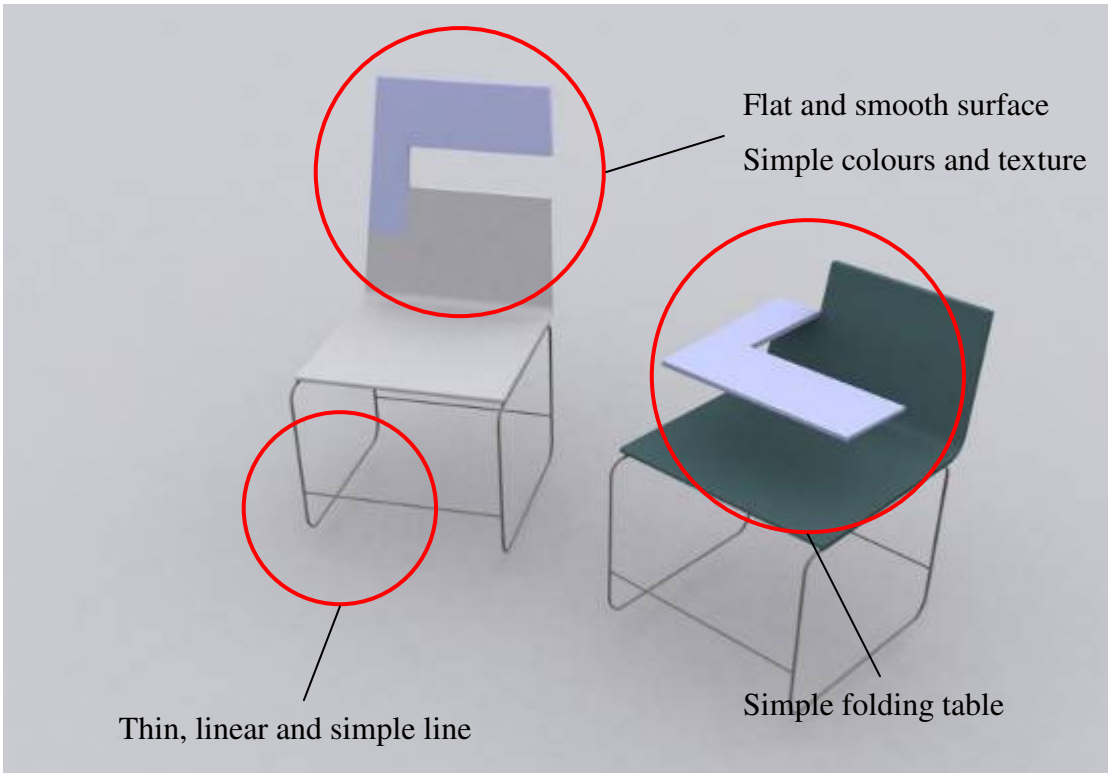
i.) Researching

Looking into other designs is probably the best way to begin your creative process. You should start by taking a study tour in home depot, furniture or home lifestyle shop. IKEA, B&Q and Seibu are some famous spots in Hong Kong that you can find nicely designed chairs. Take pictures if you can, otherwise, leaflet and brochure provide you with the same necessary information. Magazines and the Internet can be other sources of good designs.

You may cut out the images from magazines, leaflets, brochures or printouts and stick them onto A3 paper.

ii.) Analysis

Write notes under each images, try to decode the origin of the design. What does the design look like?



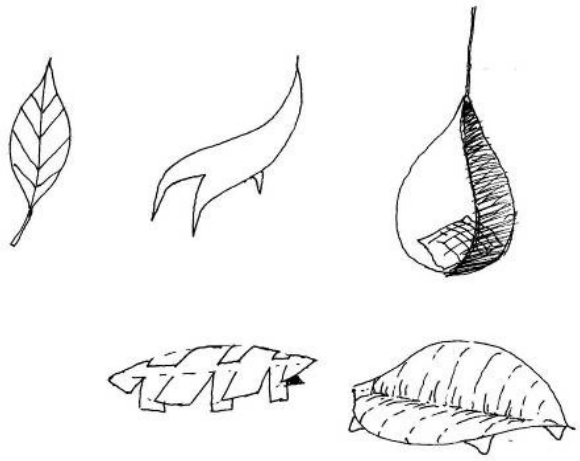
With these visual clues in mind, one can decide that the design comes from a school chair valuing simplicity, cleanliness and scholarship.

It is recommended that you search for at least 10 chairs to get your eyes seeing the lines and forms that are being hidden in the designs.

iii.) Sketching

Find an object as your basis for design. It can be simple like an egg, a leaf, a fish, an aeroplane or a pyramid.

Try to carry over the lines and forms that are visually suggestive to your design.



Example of a series of sketches showing the leaf being transformed into chair designs.

iv.) Presenting your design

In Chapter 3 Design and Communication, you have learned a range of presentations to communication your design to your client. They are:

(a) 2D sketches / drawing / rendering (Pencil, colour pencil, felt pen, marker, pastel and water colour)
(b) Computer aided design (2D printouts and 3D output)
(c) 3D prototypes (Foam, paper, cardboard, acrylic, polystyrene and mix media)

You may choose to present your ideas in different formats that can convey your concept to the audience, yet you are most confident in producing. One point to note, the closest resemblance to the real production will increase comprehension.

Further activities: Recognizing design around your home.

Theme 2 – Case Study of Problem Finding and Identification

Case Study 1 – Needs, Problems and Design Solutions

Needs are where all the design activities start with. It is the human desire to make things better, improving our surroundings. However, needs are not exactly found easily. Most of the time, a user may not know there is a need or they are confused on what they really need.

Example 1:
A man always has headache. He is not aware of it.

Example 2:
A lady always has headache. She thinks she needs medicine.

The fact is there may be other needs hidden in these cases, they can be:

(a) They both are wearing a pair of glass which is not well designed.
(b) They both are sitting on chairs without well ergonomic design in the office.
(c) They both are facing high working pressure and need relaxation.

The relation between these needs and problems can be listed below:

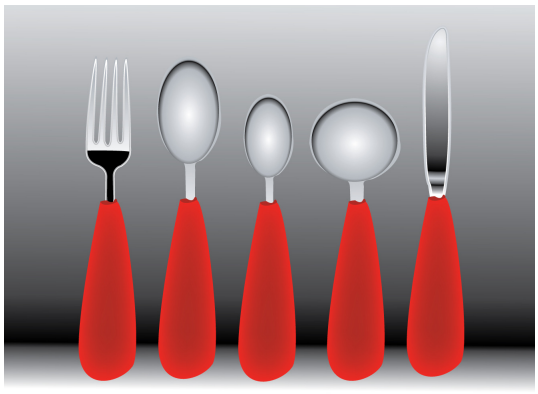
Problem	Needs	Possible design solution
By observing the user, the user keeps adjusting their glasses when reading documents.	A pair of glasses which fit the user. Not wearing glasses for too long.	Well designed glasses An alarm device to remind user of taking rest every 30 min. without glasses.
The user sit incorrectly in his office chair	Furniture set for the user including desk, chair and computer with ergonomic concern.	A well designed chair giving good support of the user wrest and arms for using the keyboard.
The user is stressful and unhappy	Relaxation required within suitable period of time.	A massage device on the office chair which automatically provides massage every 15 min.

Needs are mostly reflected as problems in reality. Problem finding is the key point of a design project. In the practical world, there are successful design cases in finding the problems.

Case Study 2 – The OXO case

Background

OXO is a company producing well-designed kitchen hand tools. They began with a few simple questions - Why do ordinary kitchen tools hurt your hands? Why can't there be wonderfully comfortable tools that are easy to use?
(Reference: http://www.oxo.com/OA_HTML/oxo/about_roots.htm)



The problem is frequently asked by housewives. However, not many companies really investigate what is wrong with the existing hand tools design.

The man who asked these questions in OXO was Sam Farber. Sam, who was the founder of the company, first questioned the effectiveness of kitchen gadgets in response to his wife Betsey's difficulty in gripping ordinary kitchen tools, due to a slight case of arthritis in her hands. The problem finding here was started from observation in our daily life.

Sam approached the design firm Smart Design and worked with gerontologist Patricia Moore to start the research that included talking with consumers, chefs and retailers.

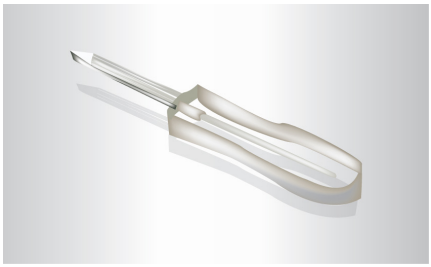
Today, OXO continues to focus on creating innovative solutions for problems that users experience in their everyday tasks.

Universal Design

OXO is based on the concept of Universal Design. But what is Universal Design and how does it benefit users? In simplest terms, Universal Design means the design of products usable by as many people as possible. In the case of OXO, it means designing products for young and old, male and female, left- and right- handed and many with special needs.

OXO is being a successful solution with their good grip handle for kitchen tools. The redesigned handle is the creative use of materials with fin structure providing a comfortable touch on the handle. Their product line includes peelers, knives and snoops.

Problem	Response	Result
Why can't kitchen utensils be designed to be easy to use by people with arthritis?	Extensive user research and innovative design create comfortable tools for all	Creative Design with high effectiveness and efficiency



Original

OXO peeler

OXO keeps looking for problems and needs from the users. Other than observation, OXO holds user groups to discuss how existing tools are used and summarize the problems. Many times, not only the problems are found, but creative ideas are also generated.

Research

Rather than a problem that OXO found and investigated by themselves, OXO also welcomes customer's suggestions. One woman wrote in asking why the handle on the potato masher was vertical instead of horizontal. This question led to a series of analysis on the existing potato masher and study on the problem in using it.

OXO finally introduced a new masher in 1999 with a horizontal handle that enables users to push down with more force. The user's needs in this case were clearly spoken out and fulfilled with the new design.

The new masher is to remind us never to stop questioning the norm and looking for improvements.

OXO i-series potato masher

Original potato masher

Product Standard

In the awareness of fulfilling the product standard, international standards were considered through the design process. For the use of materials like plastic, a high standard must be achieved on high temperature resistance, chemical resistance, strength, stress and other necessary properties.

Learning Task: Problem finding

The OXO case is a prefect example demonstrating how problems were found in our daily life. The same process can be easily understood as study go through similar problem findings exercise. The activities can be in group and done either in school or at home.

i.) Aim: Train students on problem finding skill through their daily life.

ii.) Task: Search for problems around you and

(a) Look for two problems
(b) Record the problems with both text and drawing (can be Photographs).
(c) Generate three idea solution from each problem
(d) Select one problem which has the most potential to explore.
(e) Present the final problem, solution and process.

iii.) Some questions led to problem findings

From the school

(a) Is the cleaning of litter bin easy in the classroom?
(b) Is the cleaning of the black board efficient?

From home

(c) Is the washing up in the morning difficult?
(d) Is the preparation of food in kitchen efficient?

Further activities: Recognizing design around your home.

Theme 3 – Presenting a Design

In Learning Task 1, you have designed a chair. You might have realized it in form of 2D or 3D and show it to your audience, family, friends, classmates and tutors. This is only the first stage in proposing a design to the clients. The real client presentation usually involves a larger group of people from different departments. They are busy and have a lot of questions to ask. Therefore, being able to present the design clearly and precisely is important.

In this learning task, you are asked to design a PowerPoint presentation to explain your chair design. Imagine that your classmates are the clients and convince them of your design.

A presentation board, discussed in Topic 3.1.1 in Chapter 3 Design and Communication, is one of the medium to communicate with your client. PowerPoint presentation is the digital version of the presentation board, and the concept of presenting text and images can be cross referred.

A. Appointing Design Agencies

In the research 'Appointing Design Agencies' done by British Design Innovation, BDI member Firedog Design, **whether or not a designer can present her/his idea clearly will affect the acceptance of a design proposal**. Eighty three percent of the clients rated **the clarity of a design presentation the most important aspect in winning a design pitch**.

In this perspective, the client is really looking for clues that the proposed design will solve their problems. These clues are often visual, supported by a clear layout of information and right emphasis to the right element. Think for a moment that a designer is presenting his design with the prototype only in hand. The group he is trying to convince may be too big. The prototype just isn't big enough to make an impact. Or, during the course of presentation, he misses some very important points. The presentation would end up disastrously.

B. A successful design presentation

In the same research, the respondents were asked 'the three things that annoy you or have annoyed you about design agencies'. The following are some extracts that are related to a design presentation:

(a) Arrogant design presentation
(b) Poor presentation of design idea
(c) Not listening to the brief
(d) Poor communications within the agency
(e) Not responding in line with brief

You may realize, now, that other than poor presentation of design idea, all others are about personal traits such as arrogance, not listening, poor communication and not responding.

In this Learning Task, we are not going to deal with personal traits. Instead, what we are really focusing on is 'Poor presentation of design idea'. There is an assumption that you have done a reasonable presentation in either 2D or 3D or Computer Aided Design in Learning Task 1 – Design a Chair.

C. Which medium is best?

The presentation board discussed in Topic 3.1.1 of Chapter 3 Design and Communication shows some good examples of instilling mood and creating atmosphere with graphic design when presenting a concept. However, some designs are better presented in digital format because there are more movement or even sound. To this end, the digital format can be:

(a) PowerPoint format
(b) Flash
(c) Movie format (Quicktime, AVI and WMV)
(d) Interactive format (Director and HTML)

Of course, you may choose any one of the above that you are confident in presenting. However, it is advised that you produce your presentation board in PowerPoint format. Reasons are simple. It is commonly available at school or at home. Its tools are simple and easy to use. Animation adds fun to the presentation. Lastly, it can be viewed through projector by a large group of audience.

D. A reminder on what are needed on the presentation board

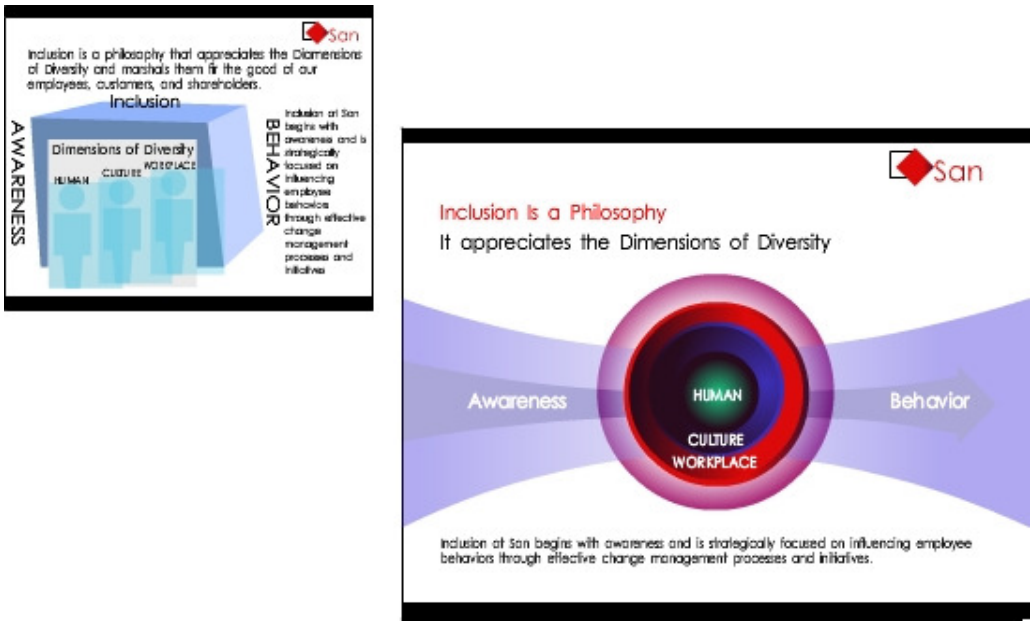
(a) The visual of the model or prototype
(b) Smaller visuals to explain different views or usage of a design
(c) The Heading
(d) Explanation notes on the concept
(e) Explanation notes on the material or production
(f) Decorative graphics

Case study – Success through PowerPoint presentation

Nancy Duarte's company is one of few companies that aim at improving visual presentation. Companies that went to her office to ask for assistance and advice were international conglomerates, such as Sun Microsystems, Citrix System, HP, Borland Software and Aspect Communications.

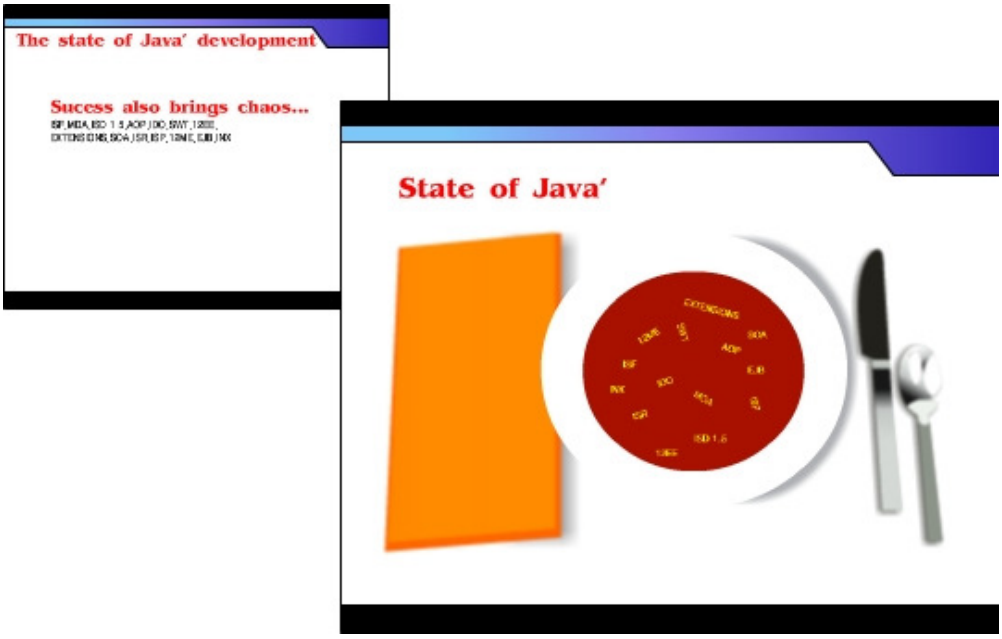
Although there are a variety of presentation media to choose from, these firms choose PowerPoint. Let's see some of the examples and explain what she had done.

Case 1: An IT Company



The smaller picture on the left is the original slide. The original slide was heavy with content that can overwhelm the audience, getting in the way of conveying important ideas. The picture on the right is clearer and inviting. Using a core graphic, cutting the amount of text and creating a heading for the slide, the slide leaves good impression on its audience.

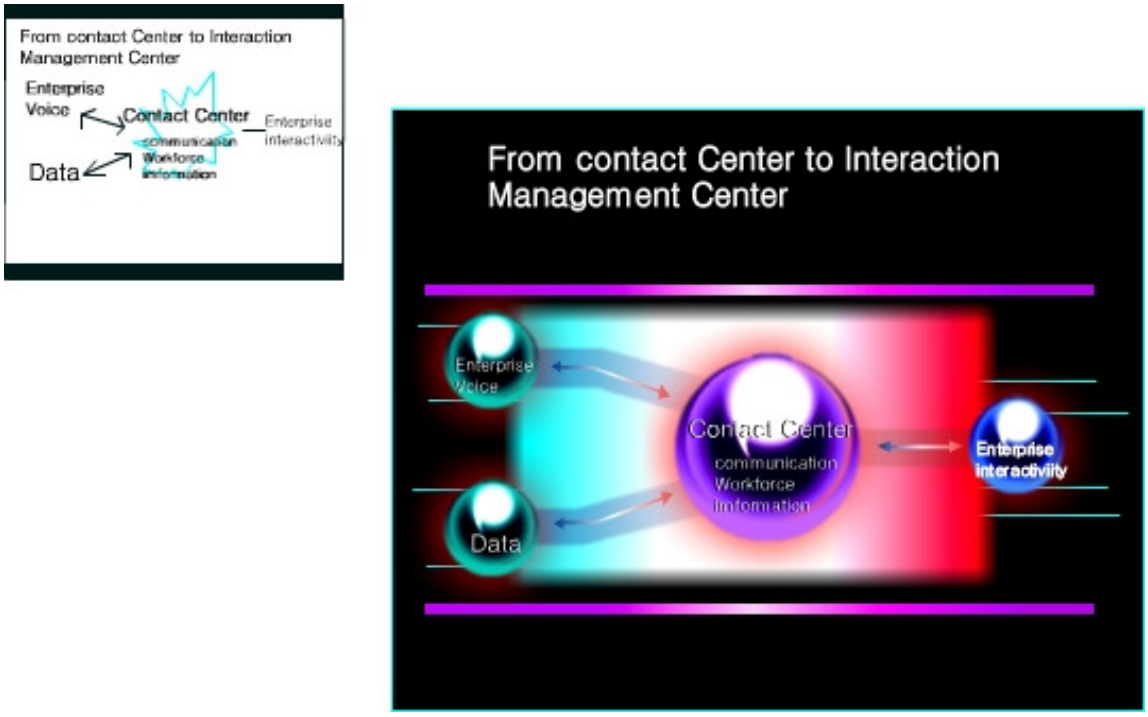
Case 2: A Software Company



The original request was to show a slide with jumbled acronyms (short forms of special terms such as SOA, SWT, EJB, …) showing the state of Java development. The title was long and an acronym collage was not visually-stimulating.

On the right of the picture, the solution to the jumbled acronyms was a metaphor of soup. Nancy's associates bought a can of alphabet soup, strained, and washed the letters and carefully placed them with a toothpick into a fresh bowl of tomato soup. The image catches the eye and draws the audience in better than an acronym-laden slide.

Case 3: A Communications Company



You can recognise that the smaller picture on the left is the original slide. It is commonly bullet pointed with text clustering on top of each other. The only graphics is the top and bottom black bars. These slides, as boring as they are, are seen hundred of times by the audience.

The revised slide uses a large arrow in the background and a core graphics of employee in the middle creating a good focus. Information is cut up into four pieces and appears with an animation as the speaker arrives at the point.

i.) What is learned here?

When we present an idea, whether or not for a design, clarity, focus and aesthetics are important. You can see from the above that clustering text and images would only overwhelm the audience. To summarize:

(a) The heading on the slide tells your audience of the intention
(b) The visual of the model or prototype should be the core graphics or image on your slide

(c) If there are smaller visuals and text to explain different views or usage of a design, try not to jam a large amount of such information in one slide. Be selective, let go of repetitive text and images.

(d) If one slide does not hold all the information you are trying to put in, use a new one until it's all contained. However, be mindful that only key points are needed. Most audiences can maintain their attention within the first 20-30 minutes of a presentation.

(e) Decorative graphics are necessary, but it should not be overdone. Remember that the design you are trying to present is the core of the whole presentation.

ii.) What you need to do

You are required to design and produce your own PowerPoint slides to present your chair design. The presentation should be within 5-10 minutes. Therefore, it should be precise and delivers the audience the special features on your chair.

PowerPoint presentation is a suggestion hopefully well conceived by you. If you feel like presenting your design in any other digital formats, please feel free to discuss it with your tutor on the possibility.

iii.) Writing your own text

You will need to draft your own heading and text. You do not need long sentences or be too rhetoric. Keep them short, precise and make sure the spelling is correct.

iv.) Taking photo of your chair design

If your previous chair design is a 3D presentation, you will need to take photos of it to be put onto the slides. You will need to zoom-in on areas with special features. Plan ahead what colour of background you need for the photo and the slide. However, if you have done CAD rendering in the presentation of your chair design, you might like to export a finer rendering for the slide.

v.) The PowerPoint presentation

A 4-6 slides presentation is sufficient. Animation, sound and other effects are completely voluntary. With the finished PowerPoint presentation in hand, you are required to present it to your classmates who you should see as your clients. If you are not too sure about how a presentation should be delivered verbally, please refer to Topic 3.1.2 Verbal presentation in Chapter 3 Design and Communication.

ASSESSMENT TASKS

Assessment Task 1: Hands-on Assignment

A. Objective

This hands-on assignment is aimed at training students to analyse an existing product and find out the problems.

B. Time schedule:

This assignment should be done after the delivery of Topic 2.1 Design Brief and Specification. The assignment will take at least 2 hours with the following lesson plan:

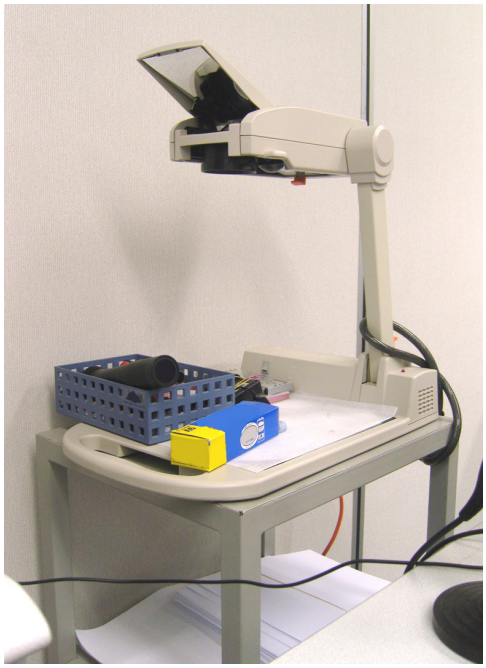
(a) Ask students to prepare in the last lesson
(b) (15 min.) Roll call
(c) (15 min.) Brief the students
(d) (30 min.) Students analyse the product
(e) (20 min.) Students summarize the findings
(f) (40 min.) Students present their findings to the class. (estimated to be 4 groups)

C. Preparation

(a) The class should be divided into groups of three; and
(b) Each group has to bring to class with:
    (i) 3 hand tools,
    (ii) A3 paper, and
    (iii) Pens, pencils and colour pencils

D. Classroom set up

(a) Classroom with desks and chairs suitable for group discussion;
(b) Appropriate PA system;
(c) Object camera / projector; and
(d) Projection screen



E. Brief

(a) Take 3 hand tools and select the one with most problems during the following process:
  (i) When using it;
  (ii) When storing it;
  (iii) When preparing to use it; and
  (iv) Aesthetic of the product
(b) Use drawings and writing to record at least 10 problems; and
(c) Present your problems to the class

Note: the product analysed can be hand tools or other daily design products.

F. Note on the analysis of the product

Answer the following questions to start the analysis on the product:

(a) When is it used?
(b) How is it used?
(c) How frequent is it used?
(d) Who will use it?
(e) To whom will it be related?
(f) Where is it used?
(g) What situation is it used?
(h) What other equipment/ materials will be used together?

G. Analyse the product when using it

(a) List the process of using the product in steps
(b) Investigate the steps of each step and find out the problems.

H. Analyse the product when storing it

(a) List how the product is stored.
(b) Investigate the problems/ needs on storing the product.

I. Analyse the preparation required for the product

List the process of the following on the product:

(a) Take this out from the storage.
(b) Set up/ prepare the tools for using it.
(c) Cleaning the tools after used.
(d) Maintenance of the tools.
(e) List out the problems from the above.

J. Analyse the aesthetic of the product

Answer the following and make suggestion:

(a) Does the form look suitable, attractive, and comfortable to the users?
(b) Do the details look suitable, attractive to the users?
(c) Does the colour look suitable, attractive, and comfortable to the users?

K. Summarize all the above problems into the following areas:

(a) Functional aspect:
    (i) When using it
    (ii) When storing it
    (iii) When preparing it
(b) Aesthetic aspect:
    (i) Form
    (ii) Details
    (iii) Colour

Assessment Task 2: Design Project

A. Introduction

This is the final design project of this Design and Innovation module. The project will take around 9 hours from the whole module. Tutorial and presentation sessions are required between sessions. Students have to presentation in expressing the design at the end. They will experience the whole design process learnt from the lessons before.

The design process gone through is:

(a) Research and Analysis
(b) Problem Identification
(c) Conceptualization
(d) Design Evaluation
(e) Design Refinement
(f) Final Visualization

B. Objective

This project is aimed at training students to practise design via the following:

(a) Experience complete process of design
(b) Develop the skill of problem finding
(c) Practice the skill on research, analysis, idea generation and design refinement
(d) Practice the idea generation method with brain storming, mind mapping, ”borrow and transfer”
(e) Practice the presentation skill in both 2D and 3D

C. Brief

Form a group of 3 students

Find a domestic daily problem and solve it creatively. The problem research area should be one of the following:

(a) Cooking
(b) Cleaning
(c) Washing

D. What to do?

i.) Research

(a) Find a domestic daily problem related to either one of the three areas. For example, the cooking stove will be filled with oil spots after each cooking.

ii.) Analysis

(a) Understand the problem by listing the important points.

(b) For instance, with the cooking stove problem, there is analysis by observation

  (i) Chinese use too much oil in cooking

  (ii) The wok isn't covered during most cooking. Covering the food makes it tasteless.

  (iii) High temperature cooking is common in Chinese culture

  (iv) Chinese appreciate cooking with sizzling oil

(c) You can make use of different research methods to come to the analysis.

iii.) Problem identification

(a) Write down the design criteria for the problem

(b) In this example, all of the analysis can be a starting point to a design. You may want to identify one that gives more possibilities to a design solution. If you choose Analysis (i), (iii) or (iv), you'll probably be recommending lesser oil in cooking or lower temperature cooking. On the other hand, Analysis (ii) gives you more possibilities in designing a wok that 'shield' the oil, yet does not cover it up.

iv.) Conceptualization

(a) Use brain storming or mind mapping

(b) Draw thumb nail sketches

(c) Select the most creative and workable idea

v.) Design Evaluation

(a) Compare the ideas generated and select the best solution

(b) Consider the functions, aesthetic, users, safety and environment

vi.) Design Refinement

(a) Further develop the idea with drawings and study model.

(b) Develop the idea into a final design

vii.) Final Visualization

Explain the problem and solution clearly by:

(a) Drawing or photo-taking of the final design

(b) Drawing or photo-taking of the problem with descriptions

(c) Drawing or photo-taking show how the problem been solved by the design

(d) Making model for explaining the design

viii.) Submission

(a) 2D presentation (mounted on A2 board)

(b) Study models

(c) Presentation model

(d) Design folder in A3 size which includes:

(i) Brainstorming and mind mapping in problem findings

(ii) Drawing and photo-taking in problem analysis (finalize 2 potential problems)

- Design criteria
- At least 30 Thumb nail sketches
- At least 10 Design sketches
- Design development sketches
- Final Design

Schedule (session)	**Marking**	**Class activities**	**Homework**
01		Briefing of project and PPT Each group of 3 students presenting the 3 problems with Research and Analysis	design criteria mind map solutions for problem, thumb nail sketches, select 10 potential ideas and further develop by drawing sketches (not more than 2 solutions on one A3 paper)
02	(20%)	Further development of possible solutions for the problem	Revised on the solutions and further analysis by detail drawings
03	(20%)	Further development of the final design technical problem Bring materials for discussion	Study models
04	(20%)	Interim critique on study models	Further develop on the study model Initial layout of presentation board
05	(20%)	Detailing of the final design, presentation board content. Detail sketches with front, side, top view	Fine tuning for final presentation
06	(20%)	Final Presentation Presentation board & model (10%) Professional attitude (10%)	

Assessment Task 3: QUIZ

Time allowed: 1 hour

Answer all the questions.

A. Multiple Choice Questions

Chapter 1 – Design in Practice

1. Unity of the design elements in a design creates harmony. What are the qualities that a designer can use to achieve unity?

   I. Shape
   II. Colour
   III. Size
   IV. Material
   V. Texture

A. I, II and IV
B. I, II, IV and V
C. II, III and IV
D. All

2. What result does the designer achieve when illusion of depth is being introduced in a design?

A. Focus
B. Visual balance
C. Movement and space
D. Explosion and energy

3. Lateral thinking is good for:

A. Making rational decision
B. Making decision from a wide range of choices
C. Making a wide range of choices for later decision
D. Making further deduction from a given choice

4. What is the sequence of project management?

   I. Teamwork
   II. Planning the execution
   III. Reviewing

IV. Executing the process
V. Setting objective

A. I, II, III, IV, V
B. V, I, IV, III, II
C. V, IV, II, III, I
D. V, II, IV, I, III

5. What is the name of the diagram below?

A. Time line diagram
B. Gantt Chart
C. Weekly record
D. Activity list

Chapter 2 – Design Consideration

1. What is the name of a comprehensive written document for a design project developed in concert by a person representing the business need for design and the designer?

A. Design process
B. Design brief
C. Design sketches
D. Rendering

2. What is the name of the chart which divides the needs into different levels?

A. Design needs chart
B. Marshall Chart of Needs
C. Maslow's Hierarchy of Needs
D. Design Strength Analysis chart

3. The following are key words involved in problem finding except…

A. User
B. Designer
C. Process
D. Task

4. What are the three methods used in problem finding?

A. observation, interview, testing
B. trying, internet, asking
C. Internet research, reading research, analytical research
D. observation, experimentation, adaptation

5. What is the full name of ISO?

A. International Organization for Standardization
B. Intelligent System Organization
C. Intellectual Properties System Ordinance
D. Internet Standardization Original Design

Chapter 3 – Design and Communication

1. What are the advantages of using orthographic drawing to show a 3D design?

I. Show the actual dimension of the design
II. Show the design in perspective
III. Show the parts of the design in their absolute proportion and scale
IV. Dimensions and details are highly comprehensible
V. Convey a moody atmosphere

A. I, III and IV
B. II, III and V
C. II, IV and V
D. III, IV and V

2. How many degrees are the left and right lines tilted in isometric drawing?

A. 10°
B. 20°
C. 30°
D. 40°

3. Which of the media below is NOT suitable for a 3D prototype?

A. Paper / cardboard
B. Marker
C. Foam
D. Polystyrene

4. What does 'perspective' mean in drawing?

A. A transparent material
B. The ability to see through thing
C. A colourful rendering mounted for presentation
D. The diminishing effect of the sizes of objects when they are farther away from the viewer

5. Which of the following can be output by CAD applications?

I. Plaster / resin 3D model
II. Inkjet printout
III. Laser-cutting

A. All
B. II and III
C. II only
D. III only

B. Long Questions

1. Explain the three properties of colour. How is colour used in creating the sense of space and depth?

2. Explain what Design Criteria is.

3. Explain the advantages of using Computer Aided Design (CAD) as a presentation medium.

4. Analyse the Nintendo DS Lite handheld game (picture showing below). List three possible levels of needs that this design belongs to according to the Maslow's hierarchy of needs. Explain why.

Remark: Features of the Nintendo DS Lite:

(a) WiFi wireless connection, available for 4 players playing game together.
(b) Series of brain-training games to improve your intelligence.
(c) Come with different colours fulfilling different lifestyles.

5. Compare the advantages and disadvantages of vertical and lateral thinking. If you are the designer of, say, a domestic dining table for a typical Hong Kong family, which method will you choose? Give reasons to support your choice.

USEFUL WEBSITES

Title	URL	Explanatory Note
Car Body Design	http://www.carbodydesign.com/	A collection of resources, technical papers, articles and links about car body design and development.
Colour Theory	http://www.artyfactory.com/colour_theory/colour_theory_terms_1.htm	A website explaining basic colour theories.
M. C. Escher	http://www.meridian.net.au/Art/Artists/MCEscher/	A website introducing Escher and his works. Escher is famous in creating interlocking positive and negative images and illusive 3D space on 2D drawing.
Modern and contemporary design blog	http://www.mocoloco.com/	A website showcasing latest product, architectural, print and textile designs.
P. L. Duffy Resource Centre of the Trinity College	http://www.trinity.wa.edu.au/pldduffyrc/subjects/it/designproc.htm	Collection of hyperlinks to explaining design process.
Stopdesign Consultant	http://www.stopdesign.com/	A website explaining a lot of design process and the latest development of which.
Olga's Gallery	http://www.abcgallery.com/alfaind.html	A website of famous artist around the world. Very useful in experiencing the use of colours in art piece.
Colour Rule of Thumb	http://www.writedesignonline.com/resources/design/rules/color.html	A website talking about the use of colours and the effects of it.
Project management	http://en.wikipedia.org/wiki/Project_management#Definitions	A website explain the definition of project management
Project management institute	http://www.pmi.org/Pages/default.aspx	A official website of Project management institute
Gantt Chart	http://www.ganttchart.com/	A website explaining the Gantt chart with examples.

Title	URL	Explanatory Note
Design Brief	http://en.wikipedia.org/wiki/Design_brief http://www.cleardesignuk.com/design-brief.html	Website of Wikipedia explaining the Design Brief Website of Clear Design UK Ltd
Maslow's Hierarchy of Needs	http://en.wikipedia.org/wiki/Needs http://chiron.valdosta.edu/whuitt/col/regsys/maslow.html	Websites explaining the Maslow's Hierarchy of Needs
Project schedule	http://en.wikipedia.org/wiki/Schedule_%28project_management%29	Website of Wikipedia explaining the Project schedule
Gantt chart	http://en.wikipedia.org/wiki/Gantt_chart	Website of Wikipedia explaining the Gantt chart
Brainstorming	http://en.wikipedia.org/wiki/Brainstorming http://edweb.sdsu.edu/triton/guides/Brainstorming.html http://www.mindtools.com/brainstm.html http://www.brainstorming.co.uk/index.html http://www.mycoted.com/Category:Creativity_Techniques	Website of Wikipedia explaining the Brainstorming Website of San Diego state of University, guides on brainstorming Website of Mindtools on creative management Website of Brainstorming on the Brainstorming Website of creativity and innovation
Mind mapping	http://en.wikipedia.org/wiki/Mind_mapping	Website of Wikipedia explaining the Mind mapping
Human Factors	http://en.wikipedia.org/wiki/Human_factor	Website of Wikipedia explaining the Human Factors
Ergonomics	http://www.iea.cc/browse.php?contID=international_ergonomics_association	Website of International Ergonomics Association
Ergonomic for schools	http://www.artyfactory.com/colour_theory/colour_theory_terms_1.htm	Website on the study of ergonomics for secondary school students
Ergonomic Society	http://www.ergonomics.org.uk/	Website of Ergonomic Society, an international organization for professionals

Title	URL	Explanatory Note
SizeChina	http://www.SizeChina.com	Website of digital database for the size of Chinese head
Product Standard	http://www.iso.org/iso/en/aboutiso/introduction/index.html#one	Website of ISO standard
ISO – International Organization for Standardization	http://www.standardsglossary.com/isoa.htm	Website of international standard
GB - Guóbiāo (國標)	http://www.etscn.com/standard-cn-gb-hous.htm	Website on Electro-test safety certification network in China standard
Federation of Hong Kong Industries	http://www.industryhk.org/english/aboutus/aboutus_obj/aboutus_obj.php	Website from Federation of Hong Kong Industries
Consumer interest	http://www.consumer.org.hk/website/ws_en/profile/mission/mission.html	Website concerning consumer interest in UK
Patent	http://www.industryhk.org/english/fs/fs_ipc/fs_ipc_ips_pat.php	Website from Federation of Hong Kong Industries
Architectural drawing	http://www.irendering.com/exteriors	Website of architectural drawings
CAD 3D rendering	http://www.rhino3d.com/	Official website of Rhino3D software
CAD 3D rendering	http://www.tutorialized.com/tutorials/3DS-MAX/1	Website introducing techniques with 3DStudio Max
Isometric drawing	http://mathforum.org/workshops/sum98/participants/sanders/Isom.html	Website introducing isometric drawings
Marker rendering	http://archive.cardesignnews.com/studio/tutorials/050518airmarker-rendering/index.html	Website of marker rendering
Marker rendering	http://www.designertechniques.com/tutorials/markrandallmarkerrender01-page1.htm	Website of marker rendering
Orthographic drawing	http://www.technologystudent.com/designpro/ortho1.htm	Website introducing orthographic drawings

Title	URL	Explanatory Note
Sizes of paper	http://www.cl.cam.ac.uk/~mgk25/iso-paper.html	Website explaining the ISO paper sizes
Team work and management case study	http://www.designology.com/	Website of design studio Designology.
HKEdCity Design and Technology (香港教育城設計與科技教育園地)	http://www.hkedcity.net/iworld/index.phtml?iworld_id=102	A platform for exchange of pedagogic development of design and technology.
Hong Kong SAR Government Support for Innovation, Design & Technology (香港特別行政區政府對創新、設計及科技的支援)	http://www.gov.hk/tc/business/supportenterprises/innovation/index.htm	Hong Kong SAR Government's webpage for linkages to other design and innovative organizations.
World Kaleidoscope (世界萬花筒)	http://kaleidoscope.cybertranslator.idv.tw/?cat=7	A website featuring innovative product designs from around the world.
設計狗創意工作室	http://tw.streetvoice.com/design/user-design-list.asp?sd=646939	A website featuring innovative advertising, simulated 3D, web designs and photography.
Visual Elements, The Hong Kong Polytechnic University (香港理工大學 – 視像傳意 - 視覺元素)	http://tds.ic.polyu.edu.hk/vc/t4_visual_presentation/visual_elements.htm	A website describing visual design elements.
Colour Theory (色彩學概念)	http://163.32.161.9/artist/t3/teachsite/about.html	A website introducing colour theory, phenomena and application.

GLOSSARY OF TERMS

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

Term	Description
Organizational principles	The overall arrangement and organization of visual elements on 2D or 3D design.
Visual meaning	The meaning associated with a given shape or colour.
Deduction	A method of creating designs in which the designer takes away line, complicated shape or texture until the least of a shape remains.
Complementary colours	They are the opposite hues on the colour wheel. Complementary colour accentuates each other, but neutralizes each other to yield grey on mixing.
Tint	Tints are mixtures of white with a hue.
Shade	Shades are mixtures of black with a hue.
Demography	Human demography is the most well-known discipline of demography, and typically what people refer to when using the term demography. Demographic analysis can be applied to whole societies or to groups defined by criteria such as education, nationality, religion and ethnicity.
Project Management	The discipline of organizing and managing resources in such a way that the project is completed within defined scope, quality, time and cost constraints.
Gantt chart	A type of bar chart showing the schedule of project in a time line.
Log sheet	A sheet record if the task for the design stage is completed. It will also include assessment and suggestion for improvement
Team work	The concept of people working together cooperatively.
Ergonomics	Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system
Design consideration	The listed consideration in the design brief. This consideration will leads the final design in fulfilling the brief and the user's needs
Design Specification	The listed specification of the final design at the end of the design stages. This will usually be listed on the visual presentation to client.
Design brief	A comprehensive written document for a design project.

Term	Description
Maslow's Hierarchy of Needs	A theory on human needs from Maslow reflecting from the view of marketing.
Design criteria	Another term in representing design consideration in the design brief with the same meaning.
Project schedule	A schedule planned for the whole design project. The whole timeline and deadline are specifically marked.
Design outcome	A listed item for the final outcome of a design project. All items are listed on their specific format and types.
Brainstorming	An idea generation method using non logical thinking. It is an activity held in a team.
Mind mapping	An idea generation method using logical thinking. A mind map diagram will be created at the end of the activity representing different ideas.
Human factors	The study of human related to the physic, psychology, environment and interaction.
Ergonomics	The study of interaction between human and the system we live in.
ISO – International Organization for Standardization	ISO is a network of the national standards institutes. It is a standard where different countries and region can follow in ensuring quality and safety.
GB – Guóbiāo (國標)	It is a standard from China in ensuring quality and safety.
CE	It is a standard from Europe. The letters "**CE**" are the abbreviation of French phrase "**C**onformité **E**uropéene" which literally means "European Conformity".
BS	British Standard stands for the standard in United Kingdom.
A sizes	In the ISO paper size system, the height-to-width ratio of all pages is the square root of two (1.4142 : 1). In other words, the width and the height of a page relate to each other like the side and the diagonal of a square. This aspect ratio is especially convenient for a paper size. If you put two such pages next to each other, or equivalently cut one parallel to its shorter side into two equal pieces, then the resulting page will have again the same width/height ratio.
Perspective	A vanishing point is a point in a perspective drawing to which parallel lines appear to converge. The number and placement of the vanishing points determines which perspective technique is being used.

Term	Description
Polystyrene	Polystyrene is a polymer made from the monomer styrene, a liquid hydrocarbon that is commercially manufactured from petroleum by the chemical industry. At room temperature, polystyrene is normally a solid thermoplastic, but can be melted at higher temperature for moulding or extrusion, then re-solidified. Styrene is an aromatic monomer, and polystyrene is an aromatic polymer.
Raster graphics	A raster graphics image, digital image, or bitmap, consists of a data file or of a data structure representing a generally rectangular grid of pixels, or points of colour, viewable via a computer monitor, paper, or other display medium.
Thermoplastic	A thermoplastic is a material that is plastic or deformable, melts to a liquid when heated and freezes to a brittle, glassy state when cooled sufficiently.
Vanishing point	A vanishing point is a point in a perspective drawing to which parallel lines appear to converge. The number and placement of the vanishing points determines which perspective technique is being used.
Vector graphics	Vector graphics (also called geometric modelling or object-oriented graphics) is the use of geometrical primitives such as points, lines, curves, and polygons, which are all based upon mathematical equations to represent images in computer graphics.
Walkthrough animation	Also called architectural animation. It is the art of creating three-dimensional images and videos illustrating an architectural proposal. As opposed to architectural rendering, which essentially creates a "flat" image, architectural animation lets the viewers see the proposed building from 360 degrees.

REFERENCES

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

De Bono, Edward (1990). *Lateral Thinking.* London: Penguin Books.

Fung, Alex et. al. (2005). *Creative Tools.* Hong Kong: School of Design, The Hong Kong 00000000000000Polytechnic University.

HKDA Executive Committee (1998). *HKDA Design Show 98.* Hong Kong: HKDA.

Lauer, A David and Pentak, Stephen (2003). *Design Basics.* Orlando: Harcourt College Publishers.

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

Panero, Julius and Zelnik, Martin (1979). *Human Dimension and Interior Space,* The Architectural Press Ltd./London.

Peter Toft (1988), *Craft & Design for Standard Grade,* Heninemann Educational Books.

Rawson, Philip (1987). *Creative Design.* London: Macdonal Orbis.

Richand Kimbell (1987), *Craft design & technology.* Thames/Hutchinson.

Tufnell, Richard (1994). *Design & Communication*. London: Stanley Thornes (Publishers) Ltd.

Wallschlaeger, Charles (1992)**.** *Basic visual concepts & principles.* Dubuque, Iowa : Wm. C. Brown Publishers.

Wong, Wucius (1972). *Principles of Two-Dimensional Design.* New York: Van Nostrand Reinhold.

Zelanski, Paul and Fisher, Mary Pat (1996). *Design Principles and Problems*. Orlando: Harcourt Brace & Company.

王無邪 (1985)。《立體設計原理》。 台北市 : 雄獅。

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。

雷曉鴻，鄺玲譯 (2004)。《工業產品設計秘訣》。Design Secrets 叢書美國工業設計師協會編 : 中國建築工業出版社。

布萊恩 (2008)。《設計師怎樣思考 : 解密設計》。 機械工業出版社。

鄔烈炎 (2004)。《設計基礎 : 來自觀念的形式》南京 : 江蘇美術出版社。

史民峰、楊大禹 、史河 (2005)。《設計色彩 : 21 世紀設計基礎新主張》。重慶 : 西南師範大學。

謝德隆 (2000)。《設計色彩學》。香港：思可出版社。

約翰.索瑞爾 (2004)。《創意之島 : 英國頂尖設計的故事》。台北市 : 五觀藝術管理。.

俞偉江 (2005)。《產品設計快速表現技法》。福州 : 福建美術出版社。

清水吉治 (2003)。《產品設計效果圖技法》。北京市 : 北京理工大學出版社。

陳重任 (2007)。《設計專利 : 理論與實務》。揚智文化。

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