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# Design and Technology: Stage 5

INTERACTIVE  
TEXTBOOK  
INCLUDED

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# Contents

<i>About the authors</i>	<i>vi</i>
<i>Acknowledgements</i>	<i>vii</i>
<i>How to use this textbook</i>	<i>viii</i>
<b>Chapter 1</b> Design concepts and processes	1
1.1 The nature of design, technology and appropriate technology	2
1.2 Purposes of design	4
1.3 Elements and principles of design	6
1.4 Disciplines of design	9
1.5 Developing design solutions	15
<b>Chapter 2</b> Developing design ideas and solutions	21
2.1 Identifying needs	22
2.2 Identifying opportunities	26
2.3 Design considerations	31
2.4 Criteria for success	35
2.5 Experimentation	37
<b>Chapter 3</b> The impact of past, current and emerging technologies	43
3.1 The work of past and current designers across a range of settings	44
3.2 Design and manufacturing careers	55
3.3 Trends in technology and design	58
<b>Chapter 4</b> The work and responsibility of designers	62
4.1 Design purpose and setting factors	63
4.2 Human, technical and environmental factors	66
4.3 Creativity and problem-solving techniques	73
<b>Chapter 5</b> Appropriate technology and ethical and responsible design	77
5.1 Ethical and responsible design	78
5.2 Design issues and appropriate technology	86
5.3 Preferred futures	91
<b>Chapter 6</b> Innovative, enterprising and creative design ideas and solutions	98
6.1 Generating creative and innovative ideas	99
6.2 Research and exploration	107
6.3 Enterprising activity	111

<b>Chapter 7</b>	<b>Appropriate techniques</b>	<b>115</b>
7.1	Communication and presentation techniques	116
7.2	Selecting an appropriate technique	121
7.3	Marketing strategies	125
<b>Chapter 8</b>	<b>Management strategies</b>	<b>130</b>
8.1	Project-management strategies	131
8.2	Time and action plans	133
8.3	Estimating financial costs	135
8.4	Managing materials, tools and techniques	137
<b>Chapter 9</b>	<b>Risk-management practices</b>	<b>150</b>
9.1	Risk management	151
9.2	Safe work practices and safe environments	154
9.3	Fair and equal opportunities	160
<b>Chapter 10</b>	<b>Selecting and using a range of technologies</b>	<b>164</b>
10.1	Selecting technologies	165
10.2	Selecting techniques	175
10.3	Evaluation and self-assessment	181
10.4	The impact of resource selection	188
	<i>Glossary</i>	<i>195</i>
	<i>Index</i>	<i>199</i>



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# How to use this textbook

## 6

### Innovative, enterprising and creative design ideas and solutions

There are many versions of the design process that designers use to create solutions to identify needs and problems. The specific process that a designer may choose to follow will often be the most practical or efficient for their situation. Integration of the various tools used, the generation of initial ideas and solving these over a brief solution design cycle between making the given design brief and the production stage of the design process.

To ensure that the best possible solution has been developed for a client, the designer will analyse their given brief to identify what the final design requires. They may include the relevant design brief and what they like, the form it could take and what materials it could be made from. The designer must then determine the best way to gather their information using the reasoning skills of their discipline. Some of these tools and techniques are explained below in this chapter.

The process of innovation is based around the inclusion of emerging technologies into existing designs. Good designers and design teams will be knowledgeable about new technologies as they are developed and released into the market. During the process of developing solutions for clients, designers bring skills to include the latest technologies into commercial success. Thereafter, they have been more evident during recent times in the development of mobile technologies, where manufacturing has led to smaller and more powerful computing technology being used to create each new generation of smartphones and tablets.

With the rise of analysis and research findings at their disposal, the designer is now best placed to begin producing innovative solutions to meet the needs of their client or target market, with research, designers will also choose the techniques best suited to their needs to ensure their creativity. These techniques will help the designer move through the design process of creating a

**Key terminology**

- Brainstorming
- Collaboration
- Client
- Entrepreneur
- Innovation
- Research
- Stakeholders
- Target market

This chapter explores some of the creative tools that designers use in order to develop the most appropriate solution to their given design brief. This features research, as it plays an important role in informing the creativity in design work. When working as an individual or collaborating with other designers as a member of a design team, innovating through enterprising approaches can help produce the creative solutions that lead to success in design.

In order to develop a clear understanding of the content of this chapter, carefully examine the 'Students learn about...' and the 'Students learn to...' statements relating to **Outcomes 5.4.1** in the New South Wales Design and Technology Year 10 syllabus.

## 6.1 Generating creative and innovative ideas

There are many versions of the design process that designers use to create solutions to identify needs and problems. The specific process that a designer may choose to follow will often be the most practical or efficient for their situation. Integration of the various tools used, the generation of initial ideas and solving these over a brief solution design cycle between making the given design brief and the production stage of the design process.

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**Figure 6.1** A person using a pen to draw on a tablet to create a design.

**Creative and innovative ideation techniques**

**Research and investigation**

Research design is a good design. It is one of the best ways to ensure that you have all the background information that you need to begin developing the best solution. This helps ensure that nothing is left behind, which is important in competitive design markets. Following the analysis of the design brief, the designer will have identified the key areas to research to ensure their design work is in the

**Chapter openers** introduce the outcomes addressed in the chapter, list **key terminology** and prepare students for the activities ahead. **Core content icons** illustrate which core content area the chapter relates to.

-  A Holistic Approach
-  Design Processes
-  Activity of Designers

**Numbered chapter headings** allow easy navigation between the textbook and the interactive version.

### CASE STUDY ANALYSIS 4.2

#### Vicki's Chair's Chair

Canadian industrial designer Vicki Solner Vicki saw the need for multifunctional furniture for young children.

Kristen Vicki was one of the first architects who took children's furniture seriously and designed furniture in a simple, modern style, but still created for the needs of the child. The Chair's Chair is not just a copy of 'grown-up' furniture, but a unique combination of practical and fun. The chair is designed to be used as a chair, but can also be used as a table for drawing or as a desk. The chair is made of wood and is a simple, clean design. It is a great example of how a simple design can be so effective. The chair is made of wood and is a simple, clean design. It is a great example of how a simple design can be so effective.

**Figure 4.2** Vicki's Chair is a simple and clean design that is suitable for children.

### CASE STUDY ANALYSIS 4.3

#### Playpen

Playpen creates innovative and timeless solutions for the young and playful at heart. The playpen is designed to be a safe and secure space for children to play in, while also being a stylish and functional piece of furniture. The playpen is made of wood and is a simple, clean design. It is a great example of how a simple design can be so effective.

**Figure 4.3** Playpen creates innovative and timeless solutions for the young and playful at heart.

## 5.1 Ethical and responsible design

**Ethics and responsibilities**

Ethics is a set of moral principles that guide our actions. In design, ethics is about making choices that are fair, honest, and respectful to all stakeholders. Designers have a responsibility to create products that are safe, functional, and aesthetically pleasing. They also have a responsibility to consider the environmental and social impacts of their designs. Ethical design is about creating products that are good for everyone.

**Ethical, responsible design and transparency**

Ethical design is about creating products that are good for everyone. It is about considering the needs of all stakeholders and making choices that are fair, honest, and respectful. Ethical design is about creating products that are good for everyone.

**Figure 5.1** Ethics is an essential part of responsible design.

### ACTIVITY 5.1

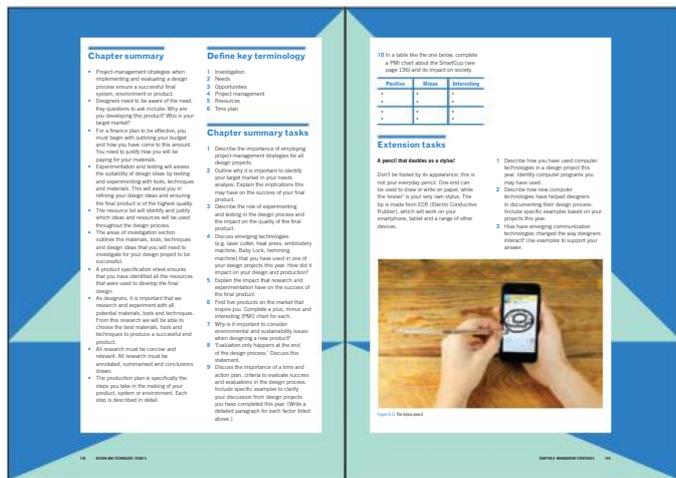
These sustainable and complex products need holistic solutions that are not just product-focused, but people-focused, locally focused and co-designed. It is a holistic design approach that considers the needs of all stakeholders and makes choices that are fair, honest, and respectful. Ethical design is about creating products that are good for everyone.

**Figure 5.2** A hand-painted ceramic vase for a kitchen table.

**Case studies** explore real-world examples that cover a range of concepts, including the processes of designing, producing and evaluating. **Analysis questions** that follow each case study allow students to demonstrate their understanding of the content and prepare them for their assessment.

Learning **activities** explore chapter outcomes, develop skills, build knowledge and understanding as well as encourage creativity.

**Glossary terms** are bolded in the text, defined in the margins and collated at the end of the textbook for easy reference.



**End-of-chapter material** includes chapter summaries, define key terminology tasks, chapter summary tasks and extension tasks to test your knowledge through the reinforcement of key outcomes and application of skills.



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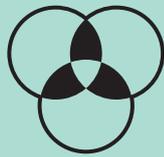
**Videos and galleries** help enhance your digital learning experience.

**Interactive activities** (e.g. drag-and-drop questions) assist the development of knowledge, understanding and skills.



# 1

## Design concepts and processes



### Key terminology

Contemporary  
Design process  
Design thinking  
Environment  
Prototype  
Society

This chapter introduces the basic concepts of design. It explores the who, what, why and how of design. The elements and principles of good design and the design process are explored. The purpose of design is illustrated by the work of individual designers. Studies reveal how modern designers take into account the impact of their designs on both humans and the environment. They seek out healthy, sustainable practices and materials to safeguard humans and protect the environment. The chapter explains how members of the design professions continue to adapt existing designs to new situations. The interdisciplinary nature of design, the significance of technology and the importance of collaborative methods for designers are all highlighted as essential components for successful design.

In order to develop a clear understanding of the content of this chapter, carefully examine the ‘Students learn about ...’ and the ‘Students learn to ...’ statements relating to **Outcome 5.1.1** in the New South Wales *Design and Technology Years 7–10 Syllabus*.

# 1.1 The nature of design, technology and appropriate technology

## design

an idea, sketch or plan to show the look and function of an object, system or environment

## invention

something made through original ideas

## technology

the use of scientific knowledge for practical purposes

## interdependent

relying on each other

Humans are thought to have been on Earth for more than four million years and throughout this time we have evidence of their ability to **design**. They designed tools to hunt and to prepare food, shelters to protect themselves from the environment, and symbols and adornments to communicate their common beliefs and rituals. Their **inventions** were aimed at improving the quality of their lives. Today our designs range from simple to complex, depending on the need. Humans have harnessed **technology** to design rich, complex environments that can be easily modified to meet their constant changing needs and desires.

Design of the twenty-first century is a complex interdisciplinary industry that plays a significant role in our lives, and in the past was aimed at providing information, shelter, food, communication, maintaining health and improving our lives. Designers start with an identified need or opportunity, a 'design brief', and through bright, imaginative ideas come up with a number of possible solutions. Testing and evaluating proposed solutions to

a problem result in the best solution being chosen and manufactured. Today we have the added assistance of the technological world of computers, to communicate, to manage and monitor machines, to collect data on efficiency, to speed up the manufacturing process, and to provide feedback on errors. One design often opens up the possibility of new designs flowing from just one idea. The rate of new technology appearing is increasing. We have a choice in the kind of technology we use, such as environmentally friendly technology, technology that meets national health and safety guidelines, and technology that considers the responsible use of precious resources.

Designers will often refer to nature for inspiration, in order to achieve the best possible design solution. The natural environment is our ancient, ancestral home. Many people will say that they have a special favourite place in nature, such as the beach, the forest or a mountain range. Humans and the natural environment are **interdependent** within the particular ecosystem. Our health, safety and future generations rely on the way each generation is able to care for its environment. It is vital for designers to consider the appropriate technology to be used in designing to ensure that the product impact on the consumer and the environment is a positive one.

## The concepts of design

### Design thinking

Design thinking emerges from a mindset based on a belief that your actions and ideas can make a difference. This type of thinking is an intentional process that is used by humans to develop new, relevant solutions that create a positive impact. Design thinking looks at 'what is' and generates a number of suggestions as to how it could be different and better. Design thinkers use all the evidence they can gather to support their various suggestions to form a conclusion on the best possible solution.

### Design processes

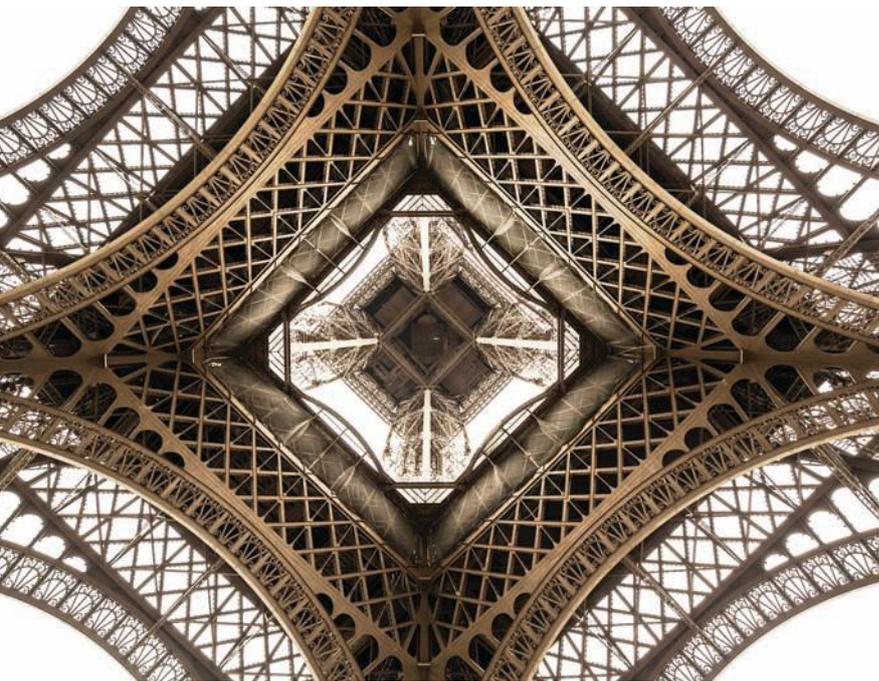


Figure 1.1 Design and technology are closely connected.

A design **process** is what puts design thinking into practice. It is a framework used to develop an understanding of the design challenge or the identified problem. A design process enables the development and evaluation of imaginative ideas for solutions to a problem. The next step moves to the **prototype** stage, the research of materials and the choice of appropriate technology to ultimately generate the best possible end product.

The key stages of the design process are interchangeable and are:

- **Exploration:** Exploring the identified challenge to gain a better understanding of what is required. What are the current problems or difficulties that the target market faces? The designer investigates the needs and wants of consumers by undertaking research, through discussions, observations or surveys.
- **Understanding:** Making meaning of research by drawing conclusions from the data gathered through observations and discussions. This information enables the designer to define the problem or need clearly and to propose new ideas to solve the problem.
- **Designing:** This stage of the design process requires the research undertaken to act as a launch pad. Brainstorming ideas individually and collaboratively assists in the development of concept sketches and models as ideas start to come to life and progress from 2D to 3D.
- **Prototyping:** This involves testing design ideas and evaluating the designs to continue to improve and achieve the optimum end result. A prototype can be a working model of the design, or an aspect of the product such as a mechanism. Designs can also be tested digitally through the use of simulations.
- **Evolution:** The final design is never actually 'The Final Design', as designs continually evolve, change and improve once they have entered the marketplace. The design process is cyclical, and designers return to the exploration stage with new information from consumers to further develop products. Evolution is the continual unfolding and development of

new products to meet new needs.

- **Evaluation:** Evaluation takes place at every stage of the design process and is continual. To **evaluate** means to make a judgement about the design, and decisions are made throughout the design process concerning the suitability of the product to fulfil the need.

The design process, if followed, is a recognised method that should meet the criteria or process the requirements of the design brief and can be confidently marketed to the target group.

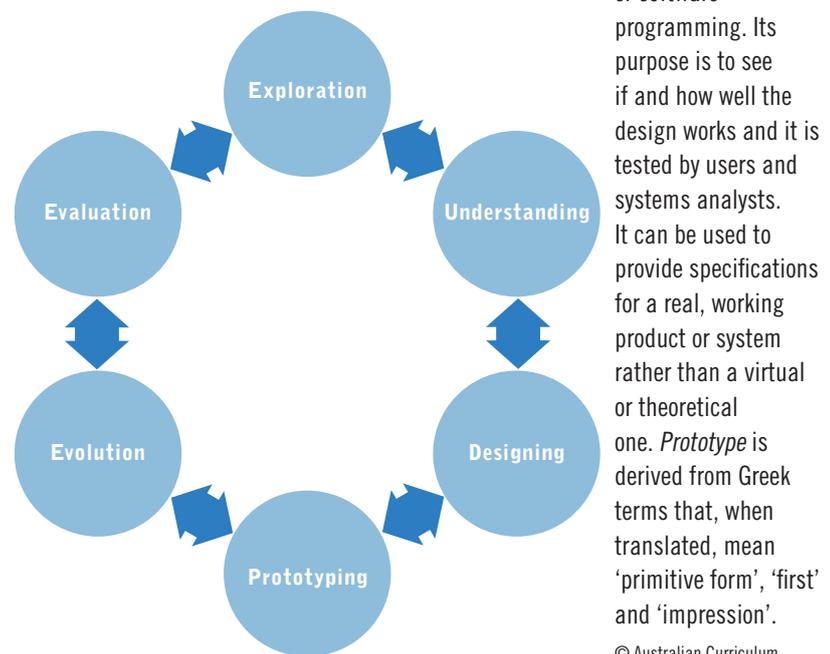


Figure 1.2 The key stages of the design process

**process**  
actions or steps taken in order to achieve an end result

**prototype**  
a trial product or model built to test an idea or process to inform further design development. A prototype can be developed in the fields of service, design, electronics or software programming. Its purpose is to see if and how well the design works and it is tested by users and systems analysts. It can be used to provide specifications for a real, working product or system rather than a virtual or theoretical one. *Prototype* is derived from Greek terms that, when translated, mean 'primitive form', 'first' and 'impression'.

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**evaluate**  
measuring performance against established criteria. Estimating nature, quality, ability, extent or significance to make a judgement determining a value.

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## ACTIVITY 1.1

- 1 Using the information above, write a definition of the following terms in your own words.
  - a Design
  - b Technology
- 2 What is considered to be appropriate/better technology? Provide two examples of the use of appropriate technology.

## 1.2 Purposes of design

### aesthetics

a branch of philosophy dealing with the nature of art, beauty and taste. It is more scientifically defined as the study of sensory-emotional values, sometimes called judgements of sentiment and taste. Aesthetic judgement is concerned with the visual impact or appeal of a product or environment and is influenced by social, emotional and demographic factors.

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A design is a plan or a sketch of how a new product, system or environment could look and function. The purposes of particular designs vary depending on the need of the target user. For example, the design of a new sports stadium would have very different requirements from the design of a national art gallery. The main purpose of any design is firstly to communicate ideas to assist designers, when discussing, testing and evaluating options for a new way to make or improve a product. If a particular design is chosen, the purpose of the design is to provide a plan for construction.

Design and the role designers play are vital in assisting us in our everyday lives. Almost everything we interact with from the moment we are born, such as the clothes we wear, the places we live in and the methods we use for cooking, have been designed for a purpose and they all aim to make our lives easier and more comfortable. We may ask what is the purpose of design. The purpose of design is to facilitate or to assist life. The consideration of basic elements such as function, **aesthetics** and ergonomics can help to modify and improve life. A design that makes our lives easier and positively assists our living, such as

an energy-efficient washing machine, would be considered 'good' design, whereas a design that hinders or inhibits our lives, such as a poorly designed office chair that causes back pain, would be seen as 'bad' design. The nature of design requires designers to consider humans and both the built and natural environments, as they are all intertwined with each other.

When designing a product, system or environment, the designer must first consider the following questions. Who is the design for? Maybe themselves? This is also known as the target market. What environment will it be in? What impact will it have on the environment and the natural environment? Looking at the purpose of design in the following focus areas, it is clear to see that the common characteristic for the purpose of design is to assist our lives.

### Medical

The technological advancements in design have enabled significant breakthroughs in the medical industry. The use of scanning and 3D printing to recreate body parts such as ears and noses has allowed doctors to repair and restore people's dignity and ability to live a normal life.



Figure 1.3 Museum of Contemporary Art, Sydney



Figure 1.4 Melbourne Cricket Ground

## Green design

Society is becoming increasingly aware of human impact on the environment and is demanding products that are more environmentally friendly, forcing designers and manufacturers to change their practices. Green design assists us to live a healthier life while at the same time reducing our impact on the environment to ensure future generations can enjoy the resources and beauty of natural environments in the years ahead.

## Agriculture

Farmers play a significant role in assisting us by growing the food we eat and gathering the fibres we wear. An area often overlooked, but just as important, the agricultural industry is a key stakeholder in the fashion, architecture and food industries. Farmers must design their property so that sustainable practices are employed and animal health is a priority. Research and development of sustainable products from plant-based materials (e.g. corn starch packaging and soy-based foams) is putting an increasing demand on the agriculture industry.

### ACTIVITY 1.2

You have the opportunity to apply for a new job in a design firm. Identify an industry of interest to you and its purpose in our society. Select a product from the industry you have chosen and answer the following questions.

- 1 Outline the purpose of the design.
- 2 Identify the user/users it is designed for.
- 3 Describe the environment it is designed to be used in.
- 4 Evaluate the effectiveness of the design. Does it assist or hinder the user?
- 5 Outline the additional areas with which the product interacts.



Figure 1.5 3D printing



Figure 1.6 Fashion designers take many important considerations into account when creating new designs.

## 1.3 Elements and principles of design

### materials

substance from which a thing is or can be made. Natural (e.g. animals, food, fibre, timber, mineral) and fabricated (e.g. metal alloys, plastics, textiles, composites) materials. Materials are used to create products or environments and their structure can be manipulated by applying knowledge of their origins, structure, characteristics, properties and uses.

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Good design addresses the basic principles of design well. A successful design carefully considers the elements and principles of design during the design process. The elements and principles of design are often referred to as the foundations of design. The principles of design direct how we apply the elements and ultimately determine how successful the design is.

### Elements of design

#### Line

The element of design known as line refers to the use of horizontal, vertical and/or curved lines to create a shape. Line can often create direction and pattern in designs.

#### Shape

A shape is generated from geometric forms (e.g. squares, circles), or organic, free-flowing natural shapes are used to create a design. Once a shape is formed, a positive and negative shape is automatically generated. Shape is very important for developing a successful design, as it relates to function and aesthetics.

### Colour

The use of colour in design can be for both functional and aesthetic purposes. The main characteristics of colour are: hue (the name of the colour, e.g. red, blue, orange), value (how dark or light) and intensity (bright or dull).

### Texture

Texture refers to the look and feel of the surface material. Is it rough, smooth, glossy, matt? How has the texture been created? What are the techniques and/or materials used? It is becoming increasingly popular to push the boundaries of texture and materials. A traditionally hard material, such as concrete, can be transformed into a smooth glossy finish by the relatively simple technique of polishing.



Figure 1.7 Colour is very important in design.



Figure 1.8 Different types of textures

### Direction

Direction is created by the use of lines. The way the lines are assembled dictates the feeling created. Horizontal lines suggest stability and calmness. Vertical lines are used to create a feeling of balance and formality. Diagonal lines suggest movement and action.

## Size

Size is simply the amount of space the design occupies. This is applied to individual objects, rooms, buildings and land.

## Principles of design

### Balance

Balance in design can be achieved by the distribution of objects. For example, a large shape close to the centre can be balanced by a small shape close to the edge. Balance is used in design to give structure and stability to the object or environment.

### Proximity

Proximity creates a relationship between the elements. It is a strategy used to link elements together. It provides a focal point. It does not mean they have to be placed together, but they should be visually connected in some way.

### Alignment

Careful and planned positioning of elements creates alignment. Alignment is the visual connection with each element. It assists to create order and organisation in the design.

## Repetition

Repeating different elements in a design strengthens the design by creating a sense of consistency. Repetition can also create a feeling of rhythm and organised movement throughout a design.

### Contrast

Contrast can promote key features of the design. It is achieved by opposing elements, such as opposite colours of the colour wheel, horizontal or vertical direction and the value of light and dark. Contrast can be used to emphasise or draw attention to different elements of the design.

### Space

Space is an important factor to consider in visual design. The use of positive and negative space, as well as the area around, between, above and below elements, must be considered.

## Applying principles of design in new situations and contexts

Some design industries have a greater emphasis on applying different principles than



Figure 1.9 Walt Disney Concert Hall, Los Angeles

others. A key principle for architecture is the way humans interact with the area around them and therefore the study of space is a high priority when designing. In comparison, the fashion industry would consider elements such as texture and colour as key features when designing patterns for garments.

### Applying design elements and principles

A design team has been given the brief to design a new sports stadium. The key elements applied to the initial design would be size, shape, line and balance.

- Size: This includes the size of land available for redevelopment, the size of the sporting field and the amount of seating required.
- Space: The use of negative space is just as important as positive space. How can designers maximise the use of all space in the design of the stadium?
- Shape: What shape maximises the above elements of design? Shape can significantly impact on the cost of the sports stadium.
- Balance: The stadium must be balanced so all customers have an uninterrupted view of the focal point, the sporting field.

Once the initial shape of the sports stadium has been established, design refinement takes place and the other elements and principles are considered in the design.

In comparison, a designer redesigning a recliner chair would consider balance, line, texture and colour as key features.

- Balance: The chair must be balanced when upright and in reclining position. It must also be balanced in visual appearance to fit in with existing furniture.
- Line: The design of the recliner is made up of both vertical and horizontal lines that need to be considered for creating a functional and aesthetically pleasing piece of furniture.
- Texture: A traditional recliner is made for comfort and therefore soft texture would be used in a range of colours and materials. Variations in texture could also be achieved through materials such as leather and fabric.

Principles such as size are predetermined through the use of **anthropometric data**.

### anthropometric data

measurements relating to the study of the human body and its movement

## ACTIVITY 1.3

A sports company wants to design a new sports bag for teenagers. On a sheet of paper, sketch your ideas for a new bag. Describe the different design features of your sports bag design. When sketching, refer to the elements and principles of design to help with the development of your ideas. Explain possible methods used in manufacturing the sports bag.



Figure 1.10 Designing a reclining armchair is very different from designing other objects.

## 1.4 Disciplines of design

The design industry encompasses many disciplines. The increase and continual development in technology is creating new design specialisations, such as digital design **software** and web design.

### Traditional design disciplines

#### Industrial design

Throughout this book you will see many examples of where industrial design is utilised. Industrial design is the design of products that specifically relate to human usage; for example, a toaster, a kettle, a drink bottle or a toothbrush. Industrial designers often work as part of a design team, researching, testing and exploring ideas through concept sketching, prototyping and evaluating. An industrial designer is often involved in the decision making of the manufacturing stage, and overseeing the development of **tooling** for the production process.



Figure 1.11 ANZAC Bridge, Sydney

#### Architecture

Architecture involves the combination of art, science, mathematics, technology and environmental awareness in the development of the built environment. The role of an

architect is to create the physical environment where people live. The design and planning of our towns, cities, park spaces, commercial and residential buildings are the work of an architect and as a result significantly impact on the quality of life by promoting social inclusion and interaction among society.

#### Interior design

An interior designer plans and organises the interiors of homes and buildings. They work as part of a design team with architects, builders and cabinetmakers to arrange space, traffic flow, furniture, lighting, flooring, fabrics and colours for the internal space.



Figure 1.12 Modern interior design

#### Graphic design

Graphic design involves the design and development of information through the use of texts, images and logos for publication. A graphic designer specialises in visual communication to an intended audience. They combine colour, page layout, symbols and illustrations into a final design for physical or digital media.

#### Fashion design

The trendsetters are drivers of our fashion industry, by designing and creating clothing, accessories and footwear. Fashion designers are heavily involved in the design process

#### **software**

programs and operating information required for the control of computers and technology

#### **tooling**

the process of acquiring the manufacturing components and machines needed for production

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### environment

one of the outputs of technology processes and/or a place or space in which technology processes operate. An environment may be natural, managed, constructed or digital.

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### humanities

the study of human culture

### market niche

a specialty area to address the needs and wants of consumers

### Newton's laws

the study of forces relating to motion – action and reaction

of their products from the development of patterns, material, samples, assembly and manufacturing details to producing the product ready for consumer use.

### Textile design

Patterns, texture, knit, weave, prints and illustrations for materials and fabrics are the results of the work of a textile designer, and may involve colour matching, complementing or contrasting together with furniture, soft furnishings and even wallpaper – making textiles into works of art.

### Television, film and set design

Combining the skills and knowledge of an interior designer and a builder, a set designer designs and oversees the production of sets for theatre, TV and film productions. This involves the customisation of walls, flooring, furniture, lighting and fabrics to create an environment specifically for a performance.

### Jewellery design

Using a range of traditional and non-traditional materials to design and make rings, necklaces, earrings, bracelets, brooches and watches, jewellery design is often detailed, intricate and tailored to individual needs, styles and personal preferences.



Figure 1.13 Jewellery design

### Furniture design

A furniture designer uses their extensive knowledge of ergonomics and the nature of the human form to design and develop furniture.

Their work is closely related to that of an interior designer and industrial designer, in that they combine technical skill to create the shape and style of furniture together with colour and furnishing of the furniture item.

All of the above listed design disciplines share the same design process. Although the disciplines have different roles and responsibilities, as well as using different materials and technologies in the development of their designs, they all follow the same steps of the design process.

## Interdisciplinary nature of design

Design encompasses many disciplines that interact with each other to create a functional and aesthetic product, system or environment. The complexity of the relationship between mathematics, science, fine arts and humanities varies in each design. When designers are searching for a market niche, they will often explore new technology through the use of science and mathematics in areas such as materials, speed, gearing and weight.

If designers were to design a product such as a new pushbike, they would need to consider the size and colour of the product, how to incorporate current technology and the environmental impact of the product. Mathematics is involved when calculating the correct sizes to cater for different heights of people in our society. As well as the weight of materials used, designers undertake research to determine if a lighter, stronger material is available within budget. In addition, the science required to understand the operations of a pushbike is extensive. A pushbike uses force to move forward and aims to overcome friction to reach maximum speed. The design team must have a strong understanding of the science of Newton's laws of motion in order for the bike to function efficiently. How can designers combine all these features into an aesthetically pleasing, age-appropriate, market-competitive bike? That is the challenge designers face on a daily basis as they work to combine all these features into their designs with the ambition to be market leaders.

In recent years, designers and society are becoming more environmentally conscious. It is a fact that the Australian population is more educated today than it was 50 years ago. Greater education and public awareness enable people



Figure 1.14 Designing a pushbike successfully requires mathematical calculations.

to realise the detrimental effects our living habits are having on the environment. Designers play an important role in minimising the effects our lives can have on the environment. As a result, design and humanities are becoming blended and we are seeing a humanitarian design movement. The interdisciplinary nature of these disciplines has led manufacturers to change their practices, search for and use sustainable resources, reduce carbon dioxide and pollution levels, as well as assess the impact of the product once it has reached the end of its life. As a result of these actions and steps, more and more products are being designed to be **biodegradable**, recycled or designed for disassembly. Petrochemical polystyrene products are being replaced with products made from cardboard and dissolvable plastics. Traditional white polystyrene takeaway cups are becoming increasingly redundant and are being replaced with cardboard cups. Double-lined

corrugated cardboard has the same insulating and watertight properties with far less impact on the environment. The cardboard cup can be easily recycled or breaks down in landfill.

The extensive scientific research into biodegradable plastics has enabled designers to implement such technology into designs. The Ford car manufacturing company is using soy-based foam products in some of its vehicles in areas such as the headrests. This technology requires science and mathematics to generate a product that provides benefits to humanity.



Figure 1.15 Cardboard cups have become increasingly prevalent in society.

**biodegradable**  
able to break down naturally

Remembering that the purpose of design is to assist our daily lives, it makes sense that humanitarian design should be the core focus for designers.

## ACTIVITY 1.4

Refer to the project you are currently studying in class. In a table like the one below, identify the range of disciplines involved in your project.

Science	Technology	Mathematics	Art	Humanities
Research properties of materials	CAD	Measurements required to make the final design	Aesthetic features – colour, shape, design, texture	Improves safety for users by ...

### wi-fi

computer code to allow devices to connect to the internet wirelessly

### hardware

the physical machines and infrastructure related to digital technology

### microtechnology

miniaturisation of computer circuits and microchips

### computer-aided design (CAD)

Software used by designers, architects and engineers to create lines, shapes and planes that can be combined, moved, rotated, adjusted and rendered. Measurements and calculations can be included. Computer-aided design can be used to create two- and three-dimensional models and drawings such as floor plans, interior and garden designs, and to represent objects and structures.

### Arduino

micro-controller based kit used to build devices and interactive objects

### LED

light-emitting diode creating high-powered light using a small amount of electricity

## Interrelationship of design with technology

Technology has significantly changed the way we do things at school, at work, for entertainment, and in our social connections. Advancements in **wi-fi**, **hardware**, software and **microtechnology** have enabled technology to be embedded into many products. Technology within our mobile phones, with the inclusion of cameras, calculators, email and other apps, has provided people with far more flexibility and convenience than the use of a mobile phone alone. The combination of multiple devices into one has allowed people to work from home and away from the office. Wi-fi and wireless technology enable this flexibility. High-speed internet promotes rapid communication and collaboration as large files containing designs can be shared and videoconferencing can take place with designers, manufacturers and specialists in the design field from all corners of the world as they evaluate and decide upon appropriate designs.

Technology has impacted on all design professions and all aspects of the design process. Traditional skills such as technical drawing are still required to communicate ideas; however, **computer-aided design (CAD)** is now considered to be the industry standard. Computer-aided design software allows designers to develop their designs on the computer. This technology has many benefits for the design industry, as designers can easily modify their designs, conduct simulations, experiments and tests, and even estimate the amount of materials required. Once a design has been developed digitally, a model, prototype or the final product could be created using computer-aided manufacturing (CAM). Factories and manufacturing processes are changing to include technology such as laser cutting, 3D printing, computer numerical control (CNC), water jet and plasma cutting. These manufacturing practices have changed the way products are designed. They have made the manufacturing process quicker, more efficient with resources, consistent in quality and less labour-intensive.

Designers embracing technology in their products are giving consumers more choice and the ability to customise designs. The increasing use of **Arduino** technology in textiles allows the wearer to change the colour of their clothing to convey a message or a theme. Wearable textiles may also have safety benefits

as designers experiment with incorporating **LED** lights and Arduino technology into jackets. This would be suitable for cyclists and motorcyclists, as indicators and brake lights could appear on the rider's back. Technology incorporated into clothing increases visibility to drivers travelling behind riders and, as a result, makes it safer for everyone on the roads.

Technology does not always refer to digital technologies. Technology can also include materials, tools and techniques used in the design and manufacturing of a product, system or environment. The technology that was used to develop bamboo into useable materials has enabled a vast new range of products. Bamboo's extensive properties and characteristics allow it to be used in a wide variety of products, from timber floorboards with excellent hard-wearing properties to clothing that is breathable, lightweight and comfortable. The research and development of materials, tools and techniques have merged together to create sustainable products for our everyday use.



Figure 1.16 Bamboo has many everyday uses.

Design and technology are interdependent as they can no longer exist without each other. Technology is driven by designers searching to find better ways of doing things and designers are driven by technology that makes their life easier. New design specialisations are developing as a result of the increase in technology, and new and exciting careers and job opportunities are becoming available.

## FLOAT House

The FLOAT House is the amazing result of collaboration between designers, architects, engineers and interior decorators all working to develop a housing solution in a natural disaster area. The long-lasting effects of destructive Hurricane Katrina in New Orleans in the United States left thousands of people homeless. Those who had homes were without power, water and sewerage facilities. Designers were given the design brief to design low-cost housing that would accommodate a single family, with the inclusion of a kitchen, bedrooms, living room and bathroom in the design. The house was not designed to protect its occupants from a hurricane, rather to minimise the devastating aftermath effects of natural disasters by allowing people to return to their homes as soon as possible.

Designers and engineers set about developing ideas of ways that the house could rise and fall with floodwaters while maintaining services such as power and water. After many months of research, observing the effects of Hurricane Katrina, experimentation with models and testing and evaluating ideas, the FLOAT House was designed.

The structural floorplan design, the 'chassis' of the house, was inspired by automotive engineers from General Motors car manufacturers. Inspired by the ability to use

the same chassis for multiple car body types, the FLOAT House also has the flexibility for customisation of house design. Not all houses would be exactly the same shape and size and the design could be altered to suit the needs of the family living there.

Some of the main problems facing people after the last hurricane were how to get fresh water and power, and how to maintain their sewerage system to avoid disease. The FLOAT House demonstrated properties similar to a raft, and the chassis design integrated all electrical, plumbing and sustainable systems of the house, allowing the house to float. To ensure the house was secure and did not float away, it was fixed to large poles that acted like masts at either end of the house, allowing the house to rise and fall in the floodwaters.

This simple idea of a floating house has the potential to save lives and homes in the future if another such flood occurs. The architects and the engineers needed to consider the forces acting on the house and the masts to make sure the house remained in position. They needed to consider the balance of the weight of the house and the ability to float. The interior designers worked to make the inside of the house attractive and a peaceful place for victims of the flood to recover from the loss of their homes.



Figure 1.17 A FLOAT House

In true architectural style, the house has been designed to fit in with existing New Orleans architecture and landscape. The FLOAT House is long and narrow, inspired by the shotgun house most common in the streets of New Orleans. Designed as a prefabricated home, it is shipped whole to the site on a flatbed truck. Once on site, it is easily installed.

The construction realisation of this design has been made possible by the interaction

and collaboration of designers from a number of disciplines, all adding to the success of the project. Architects gathered research from studying the characteristics and features of existing houses in the area. Combining this research with inspiration from the car chassis, discussions with engineers and consideration of their comments, they worked together to develop a design solution. It was vital that the different design disciplines worked together from the early stages of the design process to ensure the best possible solution was reached.

The interdisciplinary nature of the FLOAT House is evident through the design teams involved in the whole design and manufacturing process. Who would have thought that a car could influence the design of a house?

- 1 Draw a table to illustrate the interdisciplinary nature of design in the FLOAT House project. Include the stakeholders, their needs and their responsibilities.
- 2 Discuss the importance of collaboration in this project to achieve success.
- 3 Choose one feature of the design and explain how it had been used in a previous design but was able to be transferred to the new design of the FLOAT House.



Figure 1.18 FLOAT Houses are long and narrow



Figure 1.19 Shotgun houses, New Orleans

## 1.5 Developing design solutions

Designers have one of the best jobs in the world! They have the skills and knowledge to bring their ideas to life and to share their solutions with other people. Many people are designers who may not necessarily have studied design. They may have identified a need and worked to develop a solution. Doctors, scientists and mechanics could also be considered designers, as they work to solve problems. The process of developing design solutions could be very simple or very complex, depending on the nature of the problem. Regardless of the complexity, designers all undertake a similar process when developing solutions.

### Cognitive organisers

**Cognitive organisers** assist designers when starting to form solutions to a given problem.

Cognitive organisers help us to connect our ideas and thoughts together. Some ways they can be presented are through a brainstorm list, a mind map or a spider diagram. Brainstorming involves all stakeholders in the **project** simply coming together and listing ideas that come into

their heads about the design brief. Brainstorming is discussed in more detail in Chapter 6.

### Researching existing designs

Researching designs on the market helps designers to gain an understanding of what is already available. Identification of the most popular designs and analysis of the different features make it possible to determine what people are looking for in the designs. The mistakes of previous designers can be noted and avoided. Researching existing products, systems or environments also enables designers to gain an understanding of the types of materials, technologies and manufacturing processes already successfully used.

### Concept sketches

Concept sketches are a form of communication of ideas through visual diagrams. They are an important stage in the development of ideas, as this is where the design starts to take shape. Concept sketches are discussed in more detail in Chapter 6.

#### **cognitive organiser**

a visual diagram of interacting ideas, thoughts or elements

#### **project**

a set of activities undertaken by students to address specified content, involving understanding the nature of a problem, situation or need; creating, designing and producing a solution to the project task; and documenting the process. Project work has a benefit, purpose and use; a user or audience, which can provide feedback on the success of the solution; limitations to work within; and a real-world technologies context influenced by social, ethical and environmental issues. Criteria for success are used to judge a project's success.

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Figure 1.20 A concept sketch in interior design

## rendering

drawing that shows a relative relationship of elements or a form of objects using texture, colour, light, shade and tone (lightness or darkness of a colour). Rendered drawings are used, for example, in architecture to show what a building will look like or to show the form and shape of the body of a proposed car design. Rendering can be done by hand, or using computer software such as computer-aided drawing.

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## Model making and prototyping

Now that some ideas have been developed through concept sketching, small models can be created to visualise the 3D shape and form of these ideas. Models are often made from materials such as cardboard, modelling clay and balsa wood. Model making can also be in the digital form of a **rendered** 3D CAD drawing. Modelling is discussed in more detail in Chapter 6.

## Applying collaborative methods

The design industry can be a social occupation and it may require interaction between many people within design organisations, from clients to manufacturers. To collaborate means to work together and share ideas with the benefits of achieving a better quality design than one could develop on one's own. When people collaborate, they are working together to achieve a common goal, sharing knowledge, skills and building understanding of design. Collaborative methods include using effective communication methods to identify the common goal, gathering different skills from a variety of team members, ensuring that all team members are listened to and respected, and selecting an environment where the team meets, to convey a sense of equality and the freedom to be creative.



Figure 1.22 Proper collaboration is essential in executing ideas.

### Communication

Collaboration requires a high level of effective communication in order for it to be a productive process. All elements of the project must be communicated clearly so all members of the design team are aware of the common goal the team is trying to achieve and what role each member of the team has to play. When discussing design concepts, it is a good idea to use expressions such as 'I wish', 'How to' and 'What if?' as this provides a platform for further design development in a positive, proactive manner. Listening respectfully to each team member is important to ensure all contributions can be made before the team votes or decides together on the best idea for the solution.

### Diversity

When creating design teams, it is a good idea to ensure that there are a range of different design specialists on the design team. People bring different life experiences and areas of expertise, which all contribute to an effective collaboration. For example, in the development of a new car, a design team would consist of an industrial designer, interior designer, automotive engineer, aerodynamic engineer, computer programmer and paint specialist. Each designer brings an area of work expertise to the team to achieve the best possible solution to the design brief.

### Sharing

Successful collaboration requires people to share their thoughts and to be flexible with the ownership of ideas. Intellectual property is important and of course it is necessary to recognise individual ideas and thinking by acknowledging where credit is due. The end



Figure 1.21 A model of a residential house

result of the ownership of ideas and concepts must be agreed upon from the beginning. Collaboration is all about sharing and that is why it is important to establish these rules before collaboration begins.

### Environment

Schools, universities and workplaces are changing the traditional layout of the working space consisting of four walls and rows of desks in an attempt to encourage greater collaboration between individuals. Rectangular tables are being replaced by round tables, and spaces and rooms are filled with furniture designed to promote discussion and sharing of ideas to build productivity. Changing the environment can bring fresh new ideas and inspiration by creating equality of position and giving voice to all stakeholders.



Figure 1.23 Round tables promote the equal sharing of ideas.

Technology has made collaboration much easier. Design teams no longer have to be restricted to round-table discussions where everyone is physically in the same room. Videoconferencing facilities and shared documents such as Google Docs allow multiple contributors at the same time, promoting collaboration in the workplace. Such technology has allowed designers to interact and utilise each other's expertise on an international scale.

### Applying design principles in new situations and contexts

Designers set out to meet a need and often discover that their solution can be applied to many other situations. Over many years of engineering, designing and manufacturing,

the underlying design principles have largely remained the same. It is through the ability and skill of designers to be able to adapt and apply these elements and principles to new situations and contexts that we get new and innovative designs, materials and technologies.

The combination of microtechnology, touchscreen and software development has provided a platform for web-based and product designers to create a device that can assist people with their health. Smartphone software applications (apps) are proving to be an effective tool for self-monitoring type 2 diabetes. The apps have been designed for patients to easily log their blood glucose levels, carbohydrate intake, exercise and medication. The iBGStar has been developed to connect directly to an iPhone and the results of a blood glucose test are immediate. The electrochemistry technology used in the iBGStar is created from a complex mathematical method. This technology has the ability to be applied to other health-related issues in the tracking and management of medical conditions.

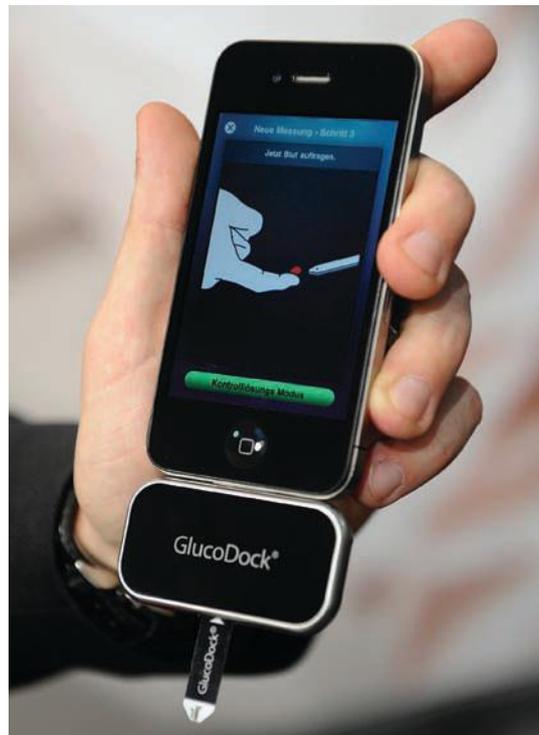


Figure 1.24 The iBGStar

Designers don't always 'reinvent the wheel'; they are creative in the way they apply ideas to different contexts. The Nest high chair, by

Australian designer Sally Dominguez, was designed from the inspiration of a motorbike helmet and a wine glass. The personal need for a safe, easy-to-clean, hygienic high chair for her young children inspired Sally to start designing. The principles of shape,

line and balance are clearly evident in the design of the Nest high chair. The spherical shape of an upside-down motorbike helmet carefully balanced on the steel stem base that resembles that of a wine glass, achieved a highly functional and aesthetic design.



Figure 1.25 The Nest high chair

## 🔍 CASE STUDY ANALYSIS 1.2

### Lily Camera

We have become a society that loves to share our activities. Hardware technology such as smartphones, cameras and other hand-held devices enables us to capture the moment, and by marrying this with social media such as Facebook, Snapchat and Instagram, we

can share with friends all over the world within minutes. The Lily Camera has taken it to the next level with the ability to fly independently in the air and track your actions.

The Lily Camera is the combination of advanced technologies to create a product where 'selfies' are hands-free and as simple as 'ready, throw, go'. Equipped with a 1080 high-definition motion camera, 12-megapixel still camera, SD card, lithium-ion battery and GPS technology, the Lily Camera is a technology-driven device. What sets it at the forefront of emerging technology are the features similar to a drone with hands-free control.

The design and manufacture of the camera body have been achieved through the use of aluminium and polycarbonate materials. Using the two materials provides strength and rigidity as well as light weight to allow the camera to fly. The aluminium has been made from CAM water-jet/laser-cutting technology, resulting in a consistent, reliable product to achieve the correct weight at only 1.3 kilograms.

The Lily tracking device, worn on your wrist, connects to GPS technology in the Lily Camera, allowing it to be no more than 30 metres in



Figure 1.26 The Lily Camera

front, behind or to the side and 15 metres above you, tracking every move. The slimline design and high-powered motors propel the Lily Camera at speeds of up to 40 kilometres per hour. All of this has been achieved through advancements in technology of materials and tools to process the materials.

- 1 How has microtechnology influenced the design and operation of the Lily Camera?
- 2 Research the process of laser cutting. How does this technology work? Describe the benefits of laser technology in manufacturing processes.
- 3 Evaluate the elements and principles of design applied to the Lily Camera.

## ACTIVITY 1.5

You are required to keep an accurate record of the design process you have undertaken in each design project. Using a computer, create a new document for word processing called 'Generation of ideas'. Record the processes you have undertaken in the design process to date, such as brainstorming, mind maps, sketches and images used for design inspirations. Record your annotations, reflections and evaluations of your sketches and ideas. Make sure your work is dated.

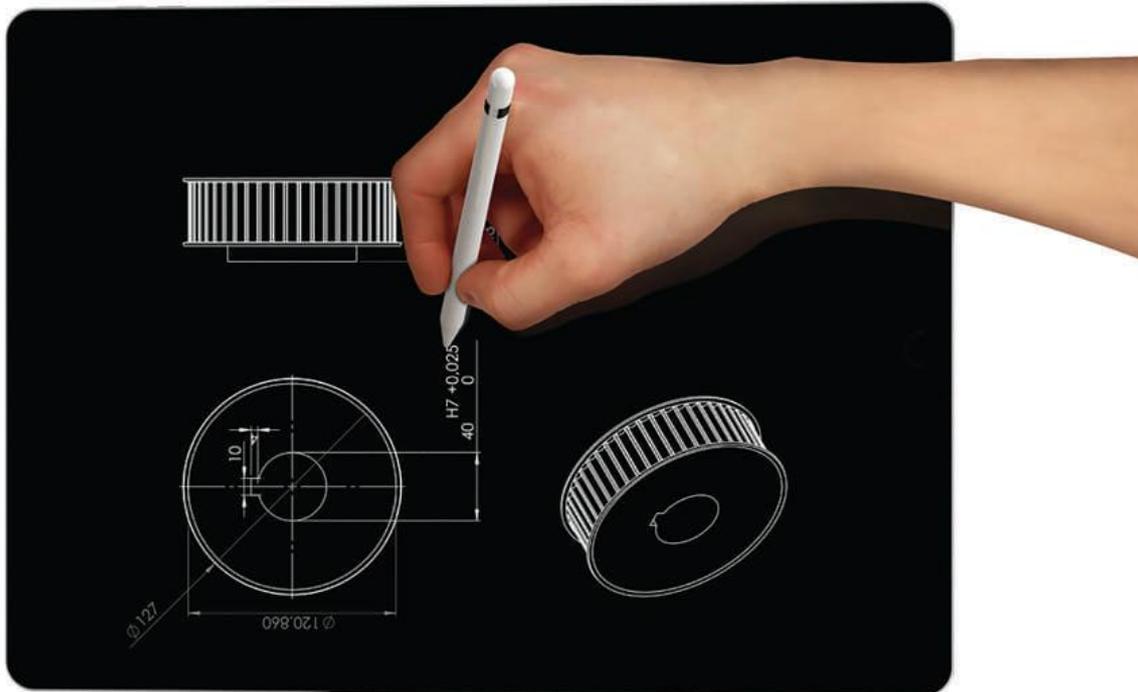


Figure 1.27 Sketch on iPad

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## Chapter summary

- Humans have had the ability to design since their earliest time on Earth.
- Human designs fulfil a need and their purpose is aimed at improving our lives, both physically and emotionally.
- The design process involves working through steps of exploration (research), understanding, designing, prototyping, evolution and evaluation.
- Good design is based on the principles of design, which direct the way we apply the elements of design.
- Design is interdisciplinary by nature and it draws on other disciplines such as science, fine art and the humanities when developing solutions.
- Design and technology are interdependent, as they can no longer exist without each other. Case studies illustrate the design process.
- The design process is collaborative.
- Designs can be applied to new situations.

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## Define key terminology

- 1 Contemporary
- 2 Design process
- 3 Design thinking
- 4 Environment
- 5 Prototype
- 6 Society

---

## Chapter summary tasks

- 1 When did humans begin to design and what is their reason for continuing to design?
- 2 List the elements of design and explain each term. Use a table for your answer.
- 3 Identify the principles of design and give a brief definition of each.
- 4 Outline the term 'design process'.

- 5 Compare the disciplines of design and identify the features they have in common and explain how they differ.
- 6 Draw a visual diagram of the key stages of the design process and provide a brief description of each step.
- 7 Using examples, describe how designers rely on technology for modern designs and explain why it is important for them to use appropriate technology.
- 8 Define the meaning of the term 'interdisciplinary' and explain how it applies to the work of designers.
- 9 Who are the stakeholders who would need to collaborate in a design project and how would they assist each other?
- 10 Choose one example of a design studied to describe how the principles used in that design can be applied to a new situation.

---

## Extension task

You have been given the task of designing a new entertainment station to be used by small children in hospital. At the moment, children have the one option of watching TV. Technology offers so much more today, but you must decide what activities are beneficial for children and contribute to their healing and well-being. In your research use a collaborative, interdisciplinary approach and let your imagination help you to find your best solution to present to the class.

# 2

## Developing design ideas and solutions



### Key terminology

**Aesthetics**  
**Digital technologies**  
**Emotional design**  
**End-users**  
**Experimental control**  
**Life-cycle analysis**  
**Market gap**  
**Market research**  
**Need**  
**Obsolescence**  
**Primary research**  
**Qualitative data**  
**Quantitative data**  
**Secondary research**  
**Stakeholders**  
**Target market**  
**Validity**

This chapter explores how designers work and apply the design process when developing new ideas for solutions to their design briefs. It describes how they research the needs of their end-users and stakeholders and set their criteria for success. Designers make decisions about their design solution and evaluate their product as they experiment and test the prototype. An interdisciplinary approach is required as they collaborate with other designers, promoters and safety experts to achieve the best possible design at that time. Identifying opportunities for new and better solutions through research, experimentation and testing is very important for capturing a broader share of the market.

In order to develop a clear understanding of the content of this chapter, carefully examine the 'Students learn about ...' and the 'Students learn to ...' statements relating to **Outcome 5.1.2** in the New South Wales *Design and Technology Years 7–10 Syllabus*.

## 2.1 Identifying needs



Figure 2.1 New designs and ideas are often generated in response to problems that need resolving.

### Identifying a need

#### need

a requirement by an individual or a group

In order to identify a **need**, we must first establish exactly what a need is. New designs and ideas flow from the imagination when sparked by a problem that seeks a solution or a better way of doing things – a need. A good example of this is the method of communicating by sending and receiving email on computers and laptops. When people moved away from their devices, they could not access their information without the internet connection. People identified a need to access their email wherever they went. A new design enabling mobile phones to receive and send email was a great solution to this problem and an advantage for users, as it gave them greater mobility throughout their day. Communication was now possible in a number of settings and workers were no longer tied to the location of their computers. This solution was successful, as it fulfilled the need of the end-user.

#### target market

a group in society with specific needs

#### trends

current colours, textures and designs in fashion

In the design industry, a need is what the **target market**, also known as the users, is asking for. This is sometimes referred to as the demand. Ultimately, the target market will determine if a product is successful or not. Identifying the needs of the target market can be done in several ways, such as studying market **trends**, engaging in and analysing target market interviews, carrying out surveys and

questionnaires and, in recent years, by using social media to assist companies in collecting feedback on consumer needs.

Market research clarifies the identification of the need and allows designers to meet the needs of the end-user more successfully. Identifying the need is achieved by answering the questions who? what? how? why? when? and where? The information gathered from research enables the problem solvers – the designers – to have a better idea of what the user requires, and this in turn directly affects the design, manufacturing and materials of the end product. The research also tells the designer if there are any products similar to the one required on the market already. This can be very helpful, as the designer would need to decide if there were any improvements that could be made to existing designs that would make the new design more appealing and capable of capturing the greatest share of the market. The designer would have to assess whether it was worthwhile proceeding with the design solution, depending on how much value the new design could add to existing designs.

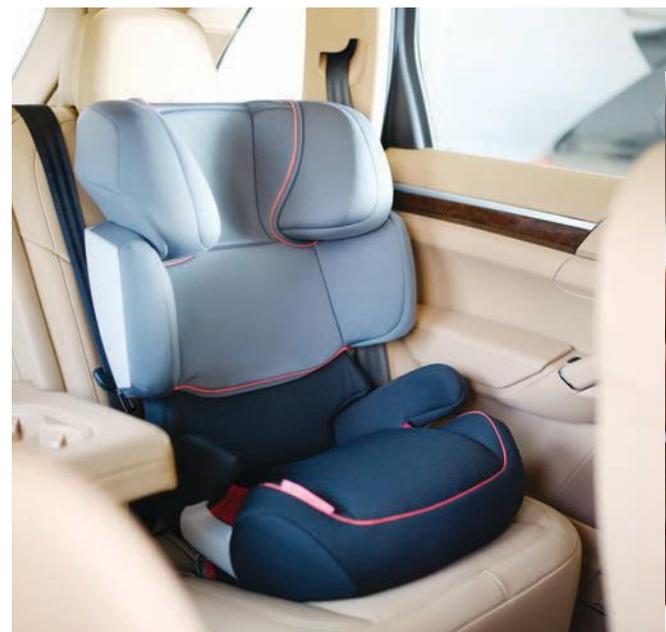


Figure 2.2 The target market for certain items, such as child car seats, is very obvious.

Everyone's needs vary and therefore products that are considered essential to some may be irrelevant to others. A child car seat, for example, is essential for parents to transport their child in the car safely. This need is only essential until the child is old enough to no longer require a car seat. In addition, it is only relevant to those who have young children. A walking frame or wheelchair would be considered an essential need for someone who cannot walk or who has difficulty with movement. These examples are identified as genuine needs for the identified target market, and the end products would be considered marketable.

A need is often derived from the user's frustrations with an existing product not meeting the current needs, or there being nothing currently available to consumers that addresses their particular needs. It is important to note that you do not need to be a designer to identify a need and develop a solution. Some of our greatest designs have been developed at home by people who have been frustrated by a problem and have set about to make a solution. The Hills Hoist clothes line was designed by Lance Hill in 1945 as a result of his wife's frustration with having to hang washing on a line strung between two posts and propped up in the middle with a stick. The utility vehicle, more commonly known as the 'ute', was developed as a result of a farmer finding it challenging to complete farm work with a car. In 1934 a vehicle that looked like a truck but had the comfort of a car was launched and has

held a dominant position in the market share of car sales all around the world ever since. This is also known as a market gap and could provide designers with a market share if their design is a success. When a problem has been identified, designers undertake vital research, and part of this research investigates whether and how the design could be applied anywhere else. The research explores the possibility of the target market being broadened and what slight modifications to the design could be made so that the design will appeal to a wider audience.

## Requirements of end-users and stakeholders

The final product resulting from the design must satisfy the end-users by fulfilling their need. Stakeholders include those who invest time, energy, professional reputation and/or brand name in the project as well as those who will ultimately buy the product.

Before designing commences, the requirements of the end-users must be considered and clarified. Identifying the users' requirements will assist in the designing of the product. Gathering this information takes time and is conducted through a range of methods. Once the information is gathered, the design brief can be more accurately refined, clearly stating the requirements of the end-users to the design team. A product will be considered successful if it meets the requirements of the end-users well and offers more than any existing designs from competitors.

A requirement is a factor that is considered necessary or compulsory. This information must come from a combination of stakeholders, such as the target market, designers, clients and manufacturers. Common requirements of a design are:

- Purpose: Why is the product being designed in the first place?
- Function: The way in which the product performs the task/s it has been designed to do.
- Ease of operation: Is the product easy to operate?
- Safety: Does the product pose any safety risks to the user? Designers must consider how these can be eliminated and the product be made safer.



Figure 2.3 Mobile phones with the capability to receive emails addressed a key need of the target market.

### primary research

research conducted first hand

### secondary research

information gathered and presented by other people

### project

a set of activities undertaken by students to address specified content, involving understanding the nature of a problem, situation or need; creating, designing and producing a solution to the project task; and documenting the process. Project work has a benefit, purpose and use; a user or audience, which can provide feedback on the success of the solution; limitations to work within; and a real-world technologies context influenced by social, ethical and environmental issues. Criteria for success are used to judge a project's success.

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- Aesthetics: Is the product appropriate to the target market? Is it aligned with current trends? Will the aesthetics make the product date and force consumers to purchase a newer model?
- Emotion: Does the design generate an emotion in the target market? Designers aim to convey that 'wow factor' to users. Do the aesthetics and function of a design make the users want to use the product more or place it on display?
- Lifespan: What is the intended lifespan of the product? The materials chosen for manufacture and the design must ensure that they meet the demands of the product's lifespan in the intended environment.

These are examples of some questions that could be discussed with stakeholders in order to refine the design brief and provide further direction in the **project**.

## Market research techniques

Conducting market research is a way of gathering essential background information on the area of your design. Building your knowledge of existing designs currently on the market, new and innovative materials, tools and techniques, social trends and consumer needs is important when developing design solutions.

Market research can be conducted in several ways through both primary and



Figure 2.4 Both primary and secondary market research need to be undertaken.

secondary sources. **Primary research** is information that is collected directly from the source (e.g. target market). This could be in the form of observation, surveys and interviews. **Secondary research** involves gathering data, reports and studies previously undertaken by another organisation and using this information in the development of your project.

Quality market research requires a combination of both qualitative and quantitative data. Qualitative data is information that cannot be measured in numerical form; for example, people's opinions, points of view, experiences, comments on pros and cons.

## Survey

A survey can be defined as a range of questions used to gather large amounts of data from the target market. Surveys can provide both quantitative and qualitative data that can be presented in a range of forms, such as graphs and tables.

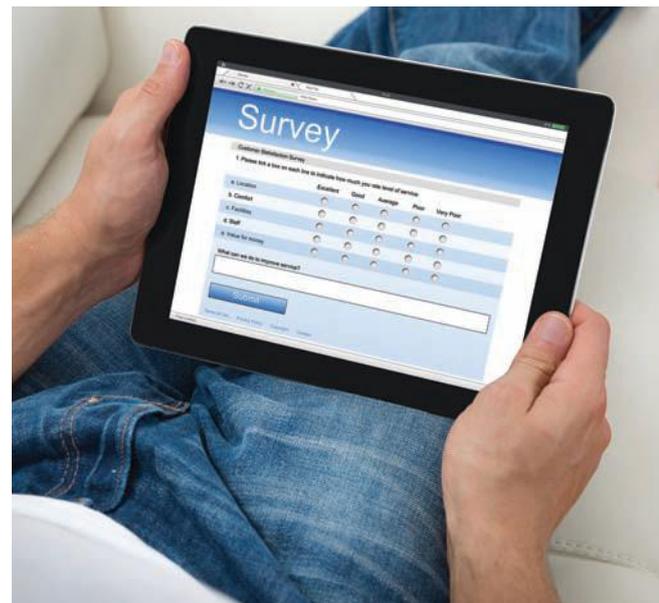


Figure 2.5 Surveys are useful for gathering large amounts of data about the target market.

## Interview

Interviews are conducted with an interviewer and the person being interviewed. The same set of questions is often used to structure the conversation and increase the validity of the survey. Sometimes a small group of people is interviewed, in order to gain a more detailed response; however, the larger the group interviewed the more reliable the data gathered becomes. An interview allows for qualitative

data and can often lead to other ideas and responses that would not normally have been gathered in a survey.

### Observation

Observation is an effective research method, as it allows people to see existing designs in operation, the target market interacting with the product and/or the results of experimentation and testing of materials, tools and techniques. Observation provides real-time feedback with designers and design teams gathering data then and there.

## ACTIVITY 2.1

Mobile devices are very popular and there is a significant increase in the sale of these products for educational purposes. You are designing a new cover for a mobile device. Identify the stakeholders for the mobile device cover and the role they play in the design and manufacturing stages. Discuss possible requirements of the end-users for a mobile device cover.

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Figure 2.6 Mobile device covers

## 2.2 Identifying opportunities

When developing design ideas that address the design brief, designers must clearly identify all the significant factors that could play a role in making the design possible and successful. Early identification of the opportunities that may contribute to the design process and the final design will assist in the development of a quality end product. The questions designers ask themselves are ‘What must we do in order to complete the design brief?’ and ‘What do we want to do to make the design different and attractive to the target market?’ To address these questions, the design team must conduct market research, and materials and technological research, and brainstorm opportunities specific to the design. Possible opportunities could include the timing of the release of the product, innovation including **multifunctional** aspects of the design to give a market edge, emotional design, the use of new materials, application of new skills, and use of available and emerging technologies.

### multifunctional

having more than one use or fulfilling multiple needs

### Timing

Timing impacts on a range of areas and could be the factor determining whether the product will succeed or fail. The relationship between timing and materials could be that the design is too advanced and the materials have not yet been discovered. As a result, alternative materials would need to be used and this could also open up an opportunity for manufacturers to develop new materials. Designers must also be able to forecast the future and develop designs that still meet the needs of the consumer in five or even 20 years’ time. What do designers need to do now to ensure their design will still be useable and in demand in future years?

### Innovation

Innovation is a result of the work of designers and engineers. They use creative thinking to generate designs, products, technologies and processes that are different from what

has traditionally taken place. Designers invent and develop innovations if they cannot find a solution that best addresses the design brief. In the development of innovative products, they may identify aspects of the design that could be used as a selling point. Some new aspects may be applied to a range of situations and enable them to gain market share over their competitors.

### Emotional design

Generating emotion in the consumer when interacting with the design can have a significant positive effect on the success of the product. Emotional design creates a pleasant experience for the end-user. It may generate feelings of fun, relaxation or excitement. Addressing the emotions in design can open up new opportunities for both designers and consumers, particularly when promotions are aimed at the target market.

### Opportunities for new and better solutions

Opportunities in design often come about as a result of someone developing an alternative to an existing design. The advancement of new technologies assists in the development of new and better solutions. The existing product could be functioning perfectly well; however, the opportunities for new and better solutions often arise as a result of more efficient manufacturing methods and changes in materials. The plastic disposable water bottle is one example that was functional; it held water without leaking, the bottle could be refilled and the plastic PET material could easily be recycled. A new design was created to use less plastic and therefore make it lighter to transport, while still maintaining the structural integrity and existing design features. Such design and thinking have a positive impact on the environment, as less plastic is required and the lighter weight means trucks can transport more bottles, making it more fuel-efficient and causing less pollution.



Figure 2.7 The plastic disposable water bottle was designed to have a positive impact on the environment.

As mentioned previously, over recent years, there have been changes in the way people think and, as a whole, society is becoming more educated. This change in thinking is also opening up opportunities for new products and designs. The notions of **market push** and **consumer pull** impact on new and better solutions. A current example of consumer pull is consumers demanding more environmentally friendly products, such as biodegradable, recyclable and design for disassembly products. People and designers are actively seeking alternatives to current practices. Plantics biodegradable plant pots, for example, could be considered to be a new and better solution to existing pots. Consumers can plant the pot containing the plant in the ground and

in only a matter of weeks the pot, made from corn starch, will have completely broken down.

The continual improvement of technology has promoted opportunities for new and better solutions. Designers have developed apps that can be used as an **interface** to operate home entertainment technology such as TV remote controls, stereos and speakers. In addition, home security systems can be controlled by smartphone technology. This is an example of how when one design changes it opens up many opportunities for other areas of design.

**interface**

a program that enables the user to operate a computer

**ACTIVITY 2.2**

Working with the person next to you, select a household item that is used regularly.

- 1 Complete a mind map of everything that interacts with the chosen item. You might like to think about what it is used for, who uses it, how it is used and when it is used.
- 2 If you were to change the setting of where the item is used (e.g. outside, in the shed or at the beach), what new opportunities might exist? How could the product be modified to cater for a new setting and opportunities? You may like to sketch and annotate your new design.

**market push**

marketing techniques employed by companies to promote their products

**consumer pull**

interest in a specific product created by a particular target market

**CASE STUDY ANALYSIS 2.1**

**Infinity laptop**

The Infinity laptop is a new solution to the current laptops used in schools. This innovative, snap-together modular design allows students to build the laptop themselves. Building on the original concept of the One Laptop per Child initiative to reduce the digital divide for less privileged or remote-area children lacking technology, One Education's mission is to empower 'parents and schools to adopt socially responsible technology, and

ensure that technology reaches those who could not otherwise afford it – creating a fair start for all'.

Providing students with access to technology so they can be connected, take part in collaborative learning environments, share their learning with others and experience a glimpse of the world beyond their immediate environment increases student engagement in learning.

## durability

an ability of an object or system to withstand or resist wear, pressure or damage over a long period of time and remain in good condition. For example, long-lasting outdoor furniture made of suitable materials and construction methods to withstand rain, heat and light from the sun; a sports uniform made of suitable materials to withstand frequent washing, and wear and tear, from the movement of the sportsperson.

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Identifying the current challenges of existing laptop technology, their lack of suitability for the environment where they will be used and the fast-paced changes in technology, One Education knew there must be a better solution. Rangan Srikhanta and his design team have gone one step further than previous designs by developing a laptop that is modular. Students not only develop their technological knowledge of how the software operates but also acquire skills in putting hardware together and upgrading parts. The laptops have been designed to last more than six years. As technology changes, so do the student's needs; with one simple snap, hardware can be changed and the capacity of the computer can be increased. If the device were to be passed on to family members and siblings, the interchangeable self-installation elements of design would make the device very economical and user-friendly.

This device is especially designed and built for children and therefore must be robust. The design requirements state that it must be lightweight, waterproof, dustproof and kid-friendly. Just looking at the pictures of the product makes you want to grab hold of the computer and start working on it. The parts can be customised and a range of colours are used to make it appealing to kids. Another



Figure 2.8 Laptops specifically tailored to children have been designed.

significant design factor required was extreme **durability**, and this has been addressed using injection-moulded heavy-duty plastic and USB connections to snap the modular parts together. The core module allows for individual preference and is not tied to a particular operating system, allowing users to select from several platforms, such as Windows and Android. All of this and more is bundled together in a compact, convenient design.

The innovative interactive 8.9-inch ultra-high-definition touchscreen technology is also supported with a keyboard cleverly designed with non-removable keys. Through research and investigation of the environment the laptop would be used in, designers have gained a good understanding of the challenges of the educational communities. They have modified an existing product using their research findings and developed an end product that addresses the needs of current and future users.

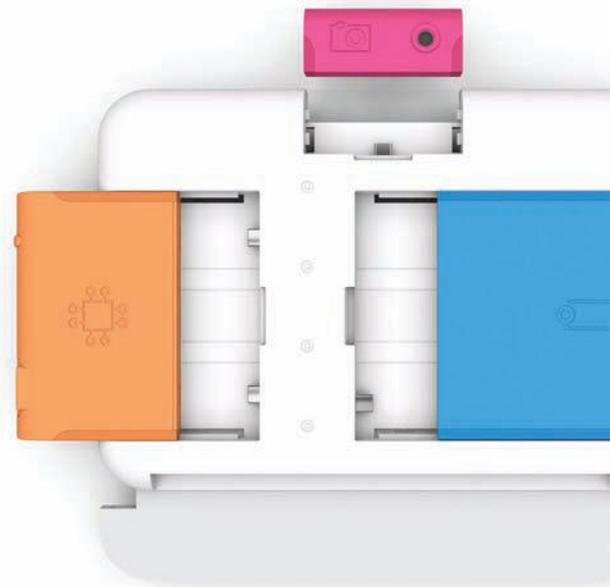


Figure 2.9 Infinity laptops are modular, allowing students to be involved in assembling or updating the hardware.

- 1 Describe the social impacts of the Infinity laptop.
- 2 How has the Infinity design team identified new opportunities?
- 3 Evaluate the effectiveness of the design in relation to the target market and technological advancement.

## Identifying the needs of end-users and stakeholders

Identifying the needs of the end-users is important when developing a design for a product. It is vital for ensuring that the product will succeed once it is placed on the market. Designers need to discuss the proposed product with the end-users and discover what their need is, how they would like the product to perform, what special features they would like it to have and what features it needs to have to be better than any existing competitors on the market. If the designer can identify a market advantage by developing the required product, it may then be possible to engage the interest of financial investors, clients, distributors, environmental scientists, advertisers and safety experts, who will collaborate to achieve the best design and effective promotion to reach the target market.

The needs of the stakeholders differ and each has a role to play in the success of the project. If it is a small project, the designers may be able to pay to develop the design themselves, such as designing a new desk organiser. If it is a large project, such as a new design for an advanced cochlear implant, more funds may be required to get the project started to demonstrate how it can generate a return of funds to the investor.

Each stakeholder has a different motivation for collaborating in the project. For the investor, it is a financial return. The designer has a creative and intellectual property input, seeking a reward for their efforts and at the same time ensuring that their professional integrity is upheld. Clients who may not need the product but can see a market niche for their retail business will also have special requirements for the designer, ranging from packaging and pricing to guarantees of reliability, durability, built-in obsolescence and refund arrangements.

Safety experts will have an interest in searching for any hazards, such as small parts that could be choking hazards in toys, as well as looking at aspects such as ease of lifting without straining muscles. Safety experts will also measure risks such as flammability, colour fastness, and toxicity of materials such as paint on toys, which children may chew. Safety experts are very strong stakeholders and receive financial rewards for guaranteeing products, having strict guidelines and standards to maintain their professional reputation.

Advertisers are important stakeholders, as it is their job to make sure that the product is promoted well and reaches a broad cross-section of the target market. They often carry

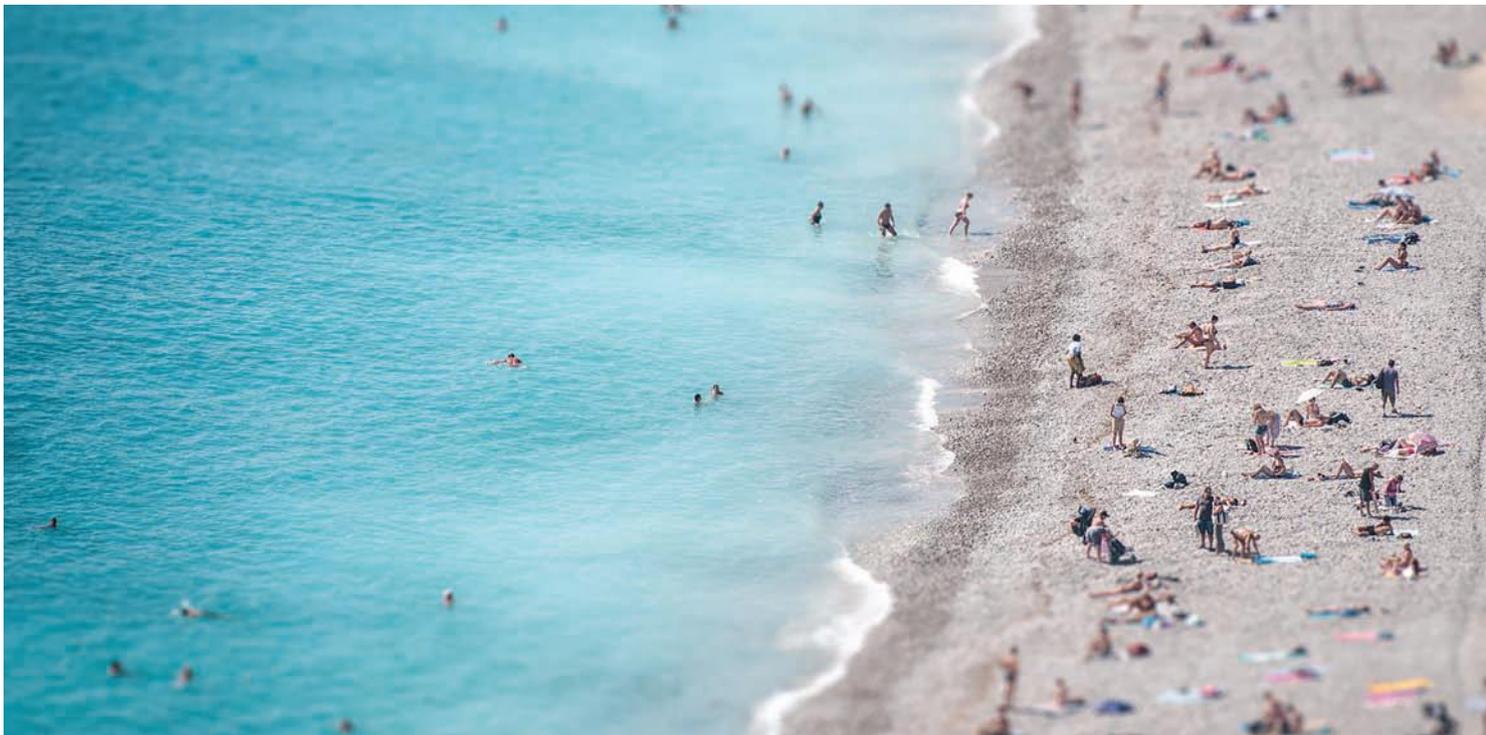


Figure 2.10 Promotion of products is very important: soft drinks are often associated with the beach.

out market research to tap into the smallest details of the needs of the end-user to make sure they are not only fulfilling their needs but also exceeding their expectations. Advertising aims to appeal emotionally to all the senses of the end-user through colour, style, sound and memories of pleasant experiences such as taste and smell, to transfer this emotion to the product being marketed and make it desirable to the end-user. The promotion needs to have a catchy twist so that the potential market will remember the advertisement and seek out the associated product. A good example is the promotion of soft drinks, where often the people with the drinks are in colourful summer settings, perhaps at a party, beach or theme park, surrounded by beautiful scenery and a relaxed atmosphere. This associates positive memories of the target market with the product being promoted, making it more desirable. The catchy part of the advertisement could be a song, a line of text, or even introducing a strange character into the advertisement so that more people will begin talking about the advertisement, helping it to reach a broader section of the market.

Environmental scientists would test the product and its proposed location to discover the impact of the product on the environment and those using the product. An example such

as building a water purification plant would involve an ecological survey to determine the impact it would have on plants, animals and humans, and especially if the project required the clearing of a space of land to build it. A life-cycle analysis of the plant apparatus and measurements of any pollution caused would also be estimated.

All the stakeholders in the development of a design project have a keen interest in meeting their own needs to achieve the success of the design solution for the end-user. Collaboration and communication between all stakeholders are essential.

### **ACTIVITY 2.3**

Write a list of your favourite designs. Select one design from your list; for example, a fashion design or a product design. Imagine you are the head designer for a design team. Outline the requirements and considerations for the chosen design. Describe how you would address each requirement throughout the design process.



Figure 2.11 Cutting fabric to a design template

## 2.3 Design considerations

Designing new products requires the consideration of key elements. Every design is different and the considerations for each product vary. These considerations often provide an element of structure for the design development process. Designers must consider:

- Purpose: What is the purpose of the design? Why is the design being implemented or manufactured? The purpose could be as simple as a new colour to the range or more complex, such as designing a new and innovative product.
- Target market: Who is the product aimed at? What is the age group or the interest group or people in society who will best benefit from the design?
- Criteria for success: How will you know if the design is successful? What tools can be used to measure the success of the product? Establishing the criteria for success early in the design brief helps to keep the design on track.
- Competition: Who is the current or potential competition in the marketplace? What works for the competition and how can you try to do it better? What is the market share of the competition and why? Developing a design with the ability to make small design modifications to maintain market share is vital in the design process.
- Branding: Giving the design a name will establish the product and give it an identity. A good product name that catches the attention of consumers will assist in promotion and marketing of the design when it enters the marketplace.
- Life-cycle analysis: The life-cycle of the product must be considered, as this will determine the materials used in manufacturing. If a toaster were designed to last three to five years, cheaper materials would be used, whereas if it was to last in excess of 10 years, heavier duty materials such as aluminium may



Figure 2.12 A brand is important in creating an identity for a product.

be used. The life-cycle will also determine the design and manufacturing process.

For example, could the product be designed for disassembly?

- Cost: The financial cost must be carefully planned early on in the design phase. A financial plan will determine the amount of money allocated to different areas of the project, from research and development, materials and manufacturing costs to employees. The cost of making the product will determine the final cost to the consumer.
- Time: When will you launch the product? Is it a good time to invest money into developing a product? Do consumers have the funds to purchase the product? Are there government **incentives** such as cash-backs and discounts for purchasing the product? An example of incentive success occurred when the government was providing consumers with financial assistance to install solar panels on their roofs. Timing is a significant factor in the success or failure of the product.

### **Incentive**

a payment or concession to motivate or encourage action

In the early stages of the design process, the above considerations must be carefully addressed and prioritised. Every design brief will place the considerations in a different order. A product may require better quality materials and innovative manufacturing techniques. As a result, this could increase costs and therefore the cost of the product would be higher for consumers. It all depends on what the stakeholders and end-users value most as the design brief is explored.

## Resource requirements

Gathering resources requires extensive research and can be a time-consuming process. Resources required for the design brief can be classified into human and non-human resources. Human resources refers to all the people who may be involved in the design process. Maximising human resources throughout the design process enables the knowledge, expertise and experience of people to be shared in the development of the design. When architects design a building, they work closely with engineers, who have a different range of expertise and skills, to ensure the design can be built. Likewise, industrial designers designing a new car body would work closely with the mechanical engineers and interior designers. When undertaking projects, designers need to consider the questions: Who could I go to for help? Who has expertise in the area I am working in?

Non-human resources are the physical materials, tools and machines that are required during the design and manufacturing process. A range of possible materials suitable to the product being designed is identified and researched. These materials are put through vigorous experimentation and testing using a range of techniques in the manufacturing process and the intended use of the product. Through research, experimentation and testing, an accurate list of resources is determined and manufacturing of the final product can commence.

Clearly establishing the resource requirements for the design brief will assist in the planning of the whole project. An action and time plan shows how long it will take to complete tasks and the estimated time for the design product to be ready for consumer use. The financial cost of each step, the materials,

the manufacturing process, the marketing and the final cost to the consumer should all be calculated.

## Appropriate technology

Throughout every project, a range of technologies is used to research, develop ideas and manufacture the final product. Today, most design firms use a combination of digital technologies and non-digital technologies.

When determining what technology is appropriate, the design considerations such as purpose, cost, time and life-cycle would be considered. These factors significantly influence the manufacturing processes. Simulation of the design can be undertaken to determine possible design flaws, estimation of materials and time it takes to manufacture the item.

## Refining design ideas to address needs and opportunities

How do designers decide on the final design? After extensive design developments and discussions with stakeholders, a final design is decided upon. The collaboration process (as discussed in the previous chapter) involves meetings and discussions where the client identifies what elements of the design they like and do not like, and the aspects of design that they would like changed or to remain. It is the client's opportunity to offer feedback to the design team. These discussions provide further direction in the refinement of the design as stakeholders work towards agreeing on a final design. It is important for all stakeholders to have input into discussions in the early stages of the project so that all involved have a very clear idea of the common goals of the design team.

Before a design is finalised, a prototype or model is usually created to see what the product will look like before mass production. This is usually the last opportunity for feedback on the design from the clients and the target market. Potential target market users may be surveyed on the product to gain an insight into their experiences with the design. After undertaking these steps, the design is refined for the last time, taking care to ensure everything is ready for mass production or final manufacture.

## ACTIVITY 2.4

Focusing on the design project you are undertaking at the moment, complete the following questions. You may like to use a table like the one below to assist in planning your work.

- 1 List all the resources you are going to require to complete your project. In your list, calculate the quantity required.
- 2 Describe how the resources will be used in your project.
- 3 Identify possible alternative resources that could be used instead of the items listed in question 1.
- 4 Justify your selection of resources.

Resource	Quantity	Resource function	Possible alternatives	Justification of selection of resources

## CASE STUDY ANALYSIS 2.2

### Water Garden

This clever invention by Back to the Roots is an excellent example of two designs combined together to create a system. Both designs, a fish tank and a garden, work harmoniously to make a closed-loop ecosystem in the Water Garden. There are many costs and benefits associated with the Water Garden. This is a domestic kit that can easily be installed in all home environments so people can enjoy their urban farm. The closed-loop system has important environmental benefits. The system operates by having pot plants in the lid of the fish tank. The fish generate ammonia waste and this is absorbed through the roots of the plants. The plants act as a filter in the water and keep the water clean.

The social benefits of the Water Garden are also valuable. The size of the garden allows it to easily be placed on a bench top where the whole family can watch the plants grow along with the fish. Children are able to interact with the Water Garden and once the plants have grown they are able to harvest their products, which have been home-grown. The family learn about the balance required

in ecosystems by observing this interaction between the aquatic environment of the fish and the terrestrial environment. All have a deeper understanding of how the organisms in the natural environment interact and produce food products.

The multiple financial costs are relevant in relation to the Water Garden as the initial outlay to purchase the product may be considered high. The Water Garden does, however, combine two products – a fish tank and a planter box. The added benefit is the constant accessibility to fresh produce such as herbs and vegetables, thereby reducing the cost of groceries. Growing produce at home also reduces the demand for food in the supermarket.

The underlying concept of the Water Garden is the balance of nature between interacting members in the ecosystem. The product is valuable as it generates interest in the requirements of plants and animals and demonstrates the importance of water for the survival of each. The product promotes the growing and consumption of fresh produce in the home. Therefore transportation from growers

to supermarkets is not required, reducing the amount of fossil fuels traditionally used in the 'gate to plate' process. The system utilises waste from the fish and instead of requiring electricity



Figure 2.13 The Water Garden is a closed-loop ecosystem that can be enjoyed as a domestic kit.

to filter the water, it incorporates plants that absorb water and nutrients to promote growth.

The designers of the Water Garden have developed not only a closed-loop aesthetically pleasing design, but also a product that can be an educational tool in the home environment. This product would have a strong appeal to parents who have an increasing concern for the need to care for the Earth for generations to follow.

- 1 Draw a flow chart of the closed-loop system of the Water Garden.
- 2 Identify the different types of energy required for the Water Garden to operate effectively.
- 3 Sketch your ideas as you design your own closed-loop system.
- 4 Describe the benefits of your design, addressing social, financial and environmental factors.
- 5 Predict how this concept could be scaled up to provide for communities struggling to find enough food. What would be the challenges facing the grower?

## Evaluating the long-term and short-term consequences

During the design process, all aspects of the design must be continually evaluated. The short-term and long-term consequences can involve environmental, financial, personal, social, functional and aesthetic factors. All designs require the initial outlay of financial investment. It is not until the product is on the market that designers start to be reimbursed for their involvement. Over recent years, a shift in thinking has made people more aware of their impact on the environment, and designers and manufacturers are undertaking life-cycle assessments (LCAs) before designs are manufactured. LCAs study the resources, inputs and outputs required as

a result of manufacturing, transporting, using and disposing of the product. This holistic view provides insights into the impact the product may have on the environment. It is also important to consider the personal and social impacts when designing the product. If a product were to be used over short or long periods of time, it should not cause the user or people in the vicinity pain or discomfort. Therefore experimentation and testing must be undertaken before production, as this would highlight and prevent possible design issues. Evaluating design ideas to foresee possible short-term and long-term consequences will assist in the whole design process and the disposal of the product once it has reached the end of its useable life.

## 2.4 Criteria for success

Establishing the **criteria for success** in the early stages of the design process generates goals to work towards to ensure the project is a success. The criteria are specific to each project and are usually formulated in consultation with the design team and the client. The criteria for success are usually broken into sections – functional, aesthetic and environmental – and by addressing these headings it is ensured that most aspects of the design are covered.

Functional criteria refer to the way the design works – how it operates. What actions are required by the user to operate or use the design? Design teams ask questions such as this and collaboratively generate answers to the identified problems. In addressing the functional criteria, areas such as ergonomics, durability, quality and user-friendliness are also addressed. Concept sketches and models may need to be created to be able to visualise the basic design and to assist with creating the criteria. Furthermore, as the design progresses, criteria could be added to the list.

Aesthetic criteria address the visual appeal of the product – the way the product looks. Possible criteria could include shape, colour, texture such as smooth or rough and surface finish such as gloss or matt. In addition, how do these factors come together to create the overall design?

Some criteria are already established through laws and regulations, and must be implemented in the design. For example, building codes are regulations that builders and architects must follow when designing and constructing a building. These codes and regulations are industry standards and/or council regulations. They are usually designed for safety reasons and/or to protect the environment or local community. Australian consumer product safety regulators are state and federal organisations that make sure businesses and companies use quality control measures to ensure the safety of consumers. If a company were designing a new bike helmet, it must follow the mandatory Australian

safety standards for a bike helmet. The essential criteria for a bicycle helmet would be:

- **Functional:** It must offer protection to the cyclist's head during impact.
- **Absorb impact:** Materials and design of the helmet must absorb the impact from a knock to the head.
- **Distribute load:** Materials, design and shape must be able to distribute the load of impact to prevent injury to the head.
- **Retention system:** An adjustable fastening mechanism must allow for the helmet to easily be placed on the user, not be removed as a result of impact, but be easily removed when not in use.
- **Weight:** The completed product must be lightweight and easily be able to be worn for several hours. It must not cause pain or discomfort to the user.

Each of these criteria has further regulations that must be adhered to.

Aesthetic criteria for a bike helmet could be:

- **Colour:** The colour of helmets will be in trend with new season bikes. Helmets are often designed as accessories for bikes and therefore the same colours are used.

### criteria for success

a descriptive list of essential features against which success can be measured. The compilation of criteria involves literacy skills to select and use appropriate terminology.

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Figure 2.14 A bicycle helmet should fulfil a variety of different essential and aesthetic criteria.

- Finish: The finish of the helmet could be matt or gloss, depending on the target market.
- Shape: Careful consideration is given to aerodynamics, safety and the elements of design to achieve the correct shape for the style of helmet.

The example of the bicycle helmet clearly shows the strict regulations and standards applied to products. It is vital for designers to

be aware of the standards in different industries because if they are not identified as criteria for success early in the development of design, a product may not reach the marketplace and/or a product recall may be required. This would be considered a design failure and could be very costly for companies. The consumer may be put in danger and suffer injuries or even death as a result of the poor product manufacture and lack of clearly identified criteria for success.

## ACTIVITY 2.5

Think of the design project you are currently undertaking. List five functional qualities and five aesthetic qualities that you would like your design to achieve. Identify possible ways you could address these criteria. You might like to set your work out by using a table like the one below.

Criteria	How it could be achieved	Evaluation
<b>Functional</b>		
<b>Aesthetic</b>		



Figure 2.15 Aerodynamics is a design consideration for bicycle helmets.

## 2.5 Experimentation

Experiments are conducted using a prototype of the product, or part of the product to be marketed as a way of discovering answers to problems or questions relating to the design. The advantage of experiments is that they can be repeated over and over again and modifications can be made until the prototype becomes more efficient. An experiment allows the designer to observe and measure first-hand how successfully the prototype achieves the design brief. Experiments use the scientific method. Each experiment has a set aim, the materials used are stated, the method should be clearly defined, the results are to be recorded accurately and a conclusion about the experiment is written. Experiments can be conducted under laboratory conditions, in the design workshop or in the shed at home.

Designers conduct experiments to determine how well a product, system or environment works. Experiments explore a range of different materials, tools and techniques, and results are evaluated to form conclusions about which set of conditions achieves the best design and prototype for the target market brief. Multiple tests can be carried out (that is, the experiment can be repeated many times) and the reliability of the test can be measured by statistics and reported with confidence. The reliability of the results for the product can enhance the appeal of the product to the client by increasing their confidence in the fact that their need will be fulfilled. Stakeholders can have greater confidence in their product after testing by experimentation.

Experimentation and evaluation allow all stakeholders to form a decision about the best possible solution for the design brief. The validity of the experiment is important and designers work to control the variables of the experiment to ensure that they are actually measuring what they think they are measuring so that results for different designs can be compared.



Figure 2.16 Experiments must be conducted using the prototype of a product.

### Testing and experimenting

The design process involves a stage where testing a prototype, model or part of the product or system is carried out. The main steps of the process include, firstly, the statement of an aim for the testing. Secondly, a list of the materials and equipment required is made, followed by a description of the method to be used for the testing. The results of the tests are then recorded in a variety of ways. Next, a written conclusion is presented and some discussion of the possible errors that may have occurred in the testing is also included. Finally, an evaluation of the testing and experimentation is made to decide whether the prototype, or part of the prototype, has achieved the design brief and whether full-scale production should then take place. The best way to explore the role of testing and experimentation in design is to use an example of a given design brief, such as 'design a biodegradable plastic shopping bag', and then work through the steps of the process to explore how testing and experimentation could be carried out.

## Aim

The aim is the intention of the testing and takes the form of a question that is to be answered in relation to the testing carried out. In this case, the question is: What is the strongest material of the five samples tested for making biodegradable shopping bags?

This test refers to the strength of the bag measured by how much weight it can carry without breaking. The dependent variable is the weight measured in the experiment and it is influenced by the independent variable, the different types of material used to make the five samples for testing.



Figure 2.17 In order to develop a biodegradable plastic bag, testing and experimenting must be done.

In relation to the design brief, there are other variables to consider for biodegradable shopping bags, such as the time it takes to break down after use, the ability of the bag to stretch, the transparency of the bag, the structure of the bag and the size and shape of the bag. These are all different variables and would require separate tests. Valid tests must refer to the aim and test one variable at a time while all of the other variables are controlled; that is, kept the same for that test.

## Materials and equipment

In the case of the biodegradable bags, five different samples of biodegradable materials

would be chosen for testing. A variety of different weights would be set aside for loading up the bag. A ruler or tape measure would be required to check that the bags were the same size. One hook would be needed to hang each bag in the same position each time a test was carried out. A list would be made as below:

- five samples of different, same size, biodegradable shopping bags
- one non-biodegradable shopping bag
- set of weights including various gram sizes: 1 g, 5 g, 10 g, 25 g, 50 g, 1 kg, 5 kg
- one large suspended hook
- one ruler
- pen and paper for recording results

## Method

The method can be written in point form so that the experiment can easily be repeated by others who wish to do so at a future time. Since the test has been completed, it is usually written in the past tense.

- 1 Five plastic shopping bags, each having the same dimensions but made of different biodegradable materials, were placed on the table for testing.
- 2 Each bag was placed on a hook and it was tested separately by gradually adding weights to the bag until the material of the bag could not support the load any longer and the bag broke.
- 3 The amount of weight that had been placed in the bag was then measured and recorded.
- 4 This experiment was repeated for each type of material 10 times. Repeating the experiment made the results more reliable, as averages could be calculated for each material tested.

Some experiments also test a product in relation to a product already on the market. The **control** experiment aims to vary only the independent variable and in this case the variables would be the same as the experimental group except for the fact that the material for the shopping bag is not biodegradable. This test could be used to compare the biodegradable bag to a non-biodegradable bag.

**control**  
a standard of  
comparison used to  
check results

## Results

The results of experiments can be recorded in a variety of ways. Tables, graphs and charts are useful ways of communicating when stakeholders meet to make the final decision for the solution for the design brief.

Tables organise the data recorded and include the units of measurements – in this case, kilograms. Trends can be observed in tables, and maximum and minimum scores noted when comparing materials.

Graphs provide results in an image that can be understood just by looking at the image. Graphs for each type of biodegradable material used in this experiment can be presented on one page and the strength of the five different materials can be compared. Sometimes in other situations graphs can be used to make predictions beyond the data collected.

Bar graphs or pie charts may be useful for recording results of other experiments.

could support without breaking depended on the material of the bag. All the other variables, such as the size of the bag and the same set of weights, should have been controlled (kept the same). Controlling the variables in this way ensures that a ‘fair test’ was carried out.

## Conclusion

The conclusion is a statement that relates to the question raised by the aim of the test. It should answer the question that the test set out to investigate – in this case, ‘What is the strongest material, from the five samples tested, used for making biodegradable shopping bags?’ The conclusion could be written in the following way.

Sample number four is the most suitable material for making biodegradable shopping bags, as it was able to support 8.2 kg, the greatest amount for all samples before the bag broke.

In this example, further tests would need to be carried out in relation to other variables, such as time for bags to degrade, appeal to the consumer and colour of the bag, to explore how well the product meets the demands of the target market.

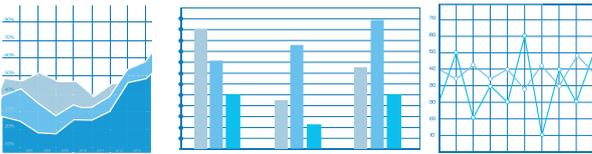
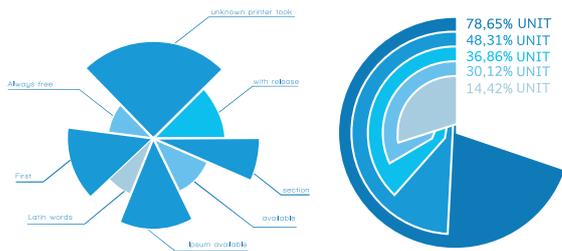


Figure 2.18 Graphs are a useful visual way to record results.

## Discussion

The discussion is a reflection on the experiment and raises any errors that may have influenced the outcome of the experiment. Suggestions can be made for improving the experiment if it is to be repeated. The variable that was tested – in this case, the strength of the different samples of biodegradable bags measured by the weight held – is called the dependent variable. In fact, the result measuring how much weight it

## ACTIVITY 2.6

You are currently working on a new design for transportable iPod speakers.

- 1 Sketch some possible design ideas and annotate your designs.
- 2 Design a survey that you can use to gather information from your identified target market group on the range of designs you have generated.
- 3 Collate data using a range of communication techniques, such as graphs and tables.
- 4 Analyse the data and report the findings to the class on which iPod speaker was the most popular. Support your response with data.

## Experimenting to optimise design solutions

To determine whether design solutions are appropriate or not and to investigate whether the design actually performs the task it was designed to do, essential experimentation and testing must be carried out to optimise design solutions. Possible experiments and tests related to projects include the testing of suitable timber joints and finishes, stitching

techniques when working with textiles, paper folds and page layout in graphic design. Undertaking a variety of experiments with a range of concept designs enables observation and assessment of the design and the most suitable design solution can then be selected with confidence. Documenting this process and results in a portfolio can be through written scientific experimentation method, graphing data, photographs, samples and prototypes.

## 🔍 CASE STUDY ANALYSIS 2.3

### HOG rainwater tank

Australian architect and designer Sally Dominguez has designed and manufactured the innovative grey-water storage tank – HOG. Sally's Nest high chair was mentioned in Chapter 1. The increasing occurrence of drought conditions in Australia and identification of wasted space when designing homes enabled Sally to identify an opportunity for design. She started to design a rainwater tank that could be used in difficult-to-access spaces and areas that are not normally used.

Investigation of modular objects and designs revealed that LEGO was an obvious and suitable inspiration for the design of the HOG. Using LEGO pieces for initial design development and concept sketching assisted in developing the shape of the tank. Extensive experimentation and testing of design ideas with a range of materials shaped the final manufacturing techniques and selection of materials. Some designs were assessed as unsuitable and further testing was required. Once it was identified that rotational moulding would be the most suitable manufacturing technique, prototypes were made and tested. As a result of testing, it became obvious that when the tank was standing upright, the bottom of the tank started to bulge. Greater design refinement took place and an effective design solution of using internal bracing was developed. The holes visible in the design go through the tank, pulling the two sides together. This created amazing structural strength that allows the HOG to lay flat, stand on its end or be wall-mounted.

The manufacturing technique of rotational moulding meant that the design was all one piece and did not consist of join seams. This technique placed the HOG as market leader in tank construction and it became evident over time that competitors' manufacturing techniques were failing. Tanks were leaking and bursting due to the seams being unable to hold the pressure of the water. The research and development invested in the early stages of the HOG design prevented a similar situation from occurring.



Figure 2.19 HOG rainwater tanks installed on a property

Testing the correct size of the HOG was undertaken on site at homes where the product was designed to be used. The HOG was placed in several locations that could be considered a negative space, such as between floor joists, along side walls of homes, under eaves and under decking. During this testing phase, other areas were identified as possible locations for HOGs, such as in wall cavities. This new opportunity had additional benefits, such as providing insulation in the walls and creating thermal insulating properties.

It is evident that as a result of extensive and thorough experimentation and testing of design ideas, the HOG rainwater tank proved to be a successful product that has won several Australian and International design awards.

- 1 Brainstorm and research existing cardboard products that have the ability to store liquid (e.g. juice boxes).
- 2 Using cardboard and a range of model-making tools, design and make a watertight storage device. Document the steps undertaken during the experiment process and present your prototype to the class.
- 3 As a class, test your designs. Discuss the different designs. Which designs worked? Which did not? Why?



Figure 2.20 The HOG rainwater tank is all in one piece because of rotational moulding.

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## Chapter summary

- Designers use market research techniques to identify the needs of end-users.
- Designs have common requirements for all stakeholders.
- Designers should consider early identification of opportunities to enhance the possibility of a successful design.
- New and better design solutions arise as a result of more advanced technology and the availability of new materials.
- Case studies illustrate the design process in action and demonstrate how new and better solutions may arise.
- Design considerations include purpose, target market, criteria for success, competition, branding, life-cycle analysis, cost and time.
- Resource requirements can be considered as human and non-human.
- Appropriate technology is influenced by design considerations.
- Criteria for success enable designers to set goals and then strive to reach them.
- Experimenting and testing are essential for refining and evaluating the design throughout the process to ensure the design brief is achieved.

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## Define key terminology

- 1 Aesthetics
- 2 Digital technologies
- 3 Emotional design
- 4 End-users
- 5 Experimental control
- 6 Life-cycle analysis
- 7 Market gap
- 8 Market research
- 9 Need
- 10 Obsolescence
- 11 Primary research
- 12 Qualitative data
- 13 Quantitative data
- 14 Secondary research
- 15 Stakeholders
- 16 Target market
- 17 Validity

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## Chapter summary tasks

- 1 Define the term 'need' in the context of the design industry.
- 2 Explain how the needs of end-users can be identified by a designer when exploring a design brief.
- 3 Who are the stakeholders in the design process and what are their requirements?
- 4 Compare the terms 'primary research' and 'secondary research' and provide examples of each.
- 5 Explain how new and better designs arise.
- 6 What are the design considerations that must be taken into account in the design process?
- 7 Explain, using examples, the difference between market push and consumer pull.
- 8 Define the term 'appropriate technology' and discuss how a decision would be made about choosing the technology for a particular design.
- 9 What aspects of design should be considered when deciding the criteria for success?
- 10 Evaluate the importance of experimenting and testing for refining the design and achieving a successful product.

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## Extension task

Designers use a range of methods to develop design ideas. Write a one-page report on the methods undertaken in the design industry to develop quality design solutions.

# 3

## The impact of past, current and emerging technologies



### Key terminology

**Cultures**  
**Environment**  
**Historical**  
**Migration**  
**Trends**

This chapter explores how past, current and emerging technologies have impacted the individual, society and environment. As designers, we need to be aware of the impact that is associated with the design of products, systems and environments on the individual, society and the environment. It is extremely important that designers consider the positive and negative consequences of their work, now and in the future. As designers, we need to consider the roles of past and current designers. Understanding careers in design and manufacture will provide us with insights into the design world. Finally, it is important to recognise design trends and how they have influenced the design industry.

In order to develop a clear understanding of the content of this chapter, carefully examine the ‘Students learn about ...’ and the ‘Students learn to ...’ statements relating to **Outcome 5.2.1** in the New South Wales *Design and Technology Years 7–10 Syllabus*.

## 3.1 The work of past and current designers across a range of settings

**multiculturalism**  
a diverse culture  
made up of various  
races, religions or  
other groups

As designers, we need to be mindful of past and current settings that impact on the way in which we design. Events, people and trends are just some areas that have influence on new products, systems and environments that are developed. Social issues directly influence present-day design and production. In order to appreciate the state of design and technology today, we should consider the influence of social issues over time, such as changing social trends, cultural diversity, the changing nature of work and technological change. Some of the most significant historical factors that have impacted on social trends include the introduction of new cultures (migration), economics, changing lifestyles and changes in family structures.

**Multiculturalism** brings richness and depth to a society from a design perspective, given the variety of influences it can offer. Religion can be a factor that determines design in fashion, jewellery, architecture and art. Also, some traditional customs are heavily design-based. Designers need to show sensitivity to the views of others. The use of sacred Aboriginal and Torres Strait Islander peoples' artwork in graphic design, for example, may be considered taboo.

Culture may be regarded as a set of spiritual, material, intellectual and emotional features of a social group or society and encompasses the art, literature, lifestyles, ways of living together, value systems, traditions and beliefs of these peoples. Cultural rights are part of human rights and provide the right of people to express themselves and participate in the cultural life of their choice.

The cultural diversity of Australian society has resulted in various products, systems and environments based on specific needs of ethnic communities. Each culture has brought traditions and customs with them. They have influenced fashion and food, bringing with them their tools, techniques and experiences. It is important that designers are aware of the cultural diversity in our country and that we respect and celebrate cultural differences in our designs.

The way we conduct our day-to-day lives, from work time to leisure time and the composition of families, has changed considerably over time. With these social shifts come opportunities for creation and design ideas to suit new situations. The women's liberation movement saw women take more prominent positions in society. Women obtained more access to jobs, politics and education. The number of women returning to work after childbirth has increased, and the age of women having their first child has risen. The percentage of women not having children has also increased. Family structures have changed with extended families, single



Figure 3.1 Aboriginal customs and traditions are still used today.

### Cultural

Cultural beliefs are predominantly influenced by the society in which we grew up. Geography, climate, religion, history, traditional practices, cuisine, morals (accepted behaviours) and laws all determine, to an extent, the cultural beliefs that we hold.

parenting, grandparent and kinship parenting, and same-sex parental households added to the mix. We have also seen the cost of living rising and average working hours increasing.

Advancements in communication technologies have enabled people to work from home (telecommuting), and some people take part-time work as a lifestyle choice. These changes in the social fabric of our society have led to design opportunities.

Consider the rise in divorce rates and single-parent households in our society, for example. As care providers, many single parents have to work and have less time at home. This has created a need for convenience products and time-saving devices. Any number of designs cater to these needs.

### Domestic, industrial and commercial settings

Designing in domestic or home settings usually involves one-off or small-scale production activities. In these settings, manufacturing techniques are usually kept as simple as possible in an attempt to keep production costs low and minimise potential problems. The design approaches need to be effective to produce products that are easy to use and are readily accepted by consumers.

Large-scale production of goods is the defining factor in industrial and commercial settings. This usually involves a large number of people in the production process and a variety of manufacturing techniques, as they employ large-scale machinery and tools. The products are more economically viable to manufacture, given the large scale. Industry, by its very nature, has more funds at its disposal to afford more sophisticated manufacturing processes and thus support heavier production costs.

In industrial and commercial settings, industries tend to use large-scale and automated machinery. When mass production is involved, added costs such as wear and tear on equipment, maintenance and labour need to be considered in the design and production processes.

Items may be designed with a certain life in mind to ensure that more units are sold to recover costs and maximise profits. Replacement products with improvements and

new features may be rolled out regularly to ensure sales are maintained.

Examples of commercial/industrial design include entertainment systems, vehicles, food products and most other consumer items.



Figure 3.2 Production lines at Krispy Kreme Doughnuts and a car manufacturer

### Historical

European settlement of Australia occurred from 1788. Prior to that, the traditional owners of the land, the Aboriginal and Torres Strait Islander peoples, had their own social order.

**self-sufficient**

able to provide for one's own needs without outside help

They were **self-sufficient** and utilised the land for their needs, constantly moving to ensure that the land was protected and to minimise their impact on it. They took care of their needs and did not exploit their land. They produced all their tools and clothing from the local environment. We still see many of these customs and practices in use today.

Modern immigration to Australia began with the first settlers. World events and various government policies over the years have focused immigration intakes on people from various countries, with surges occurring during gold-rush eras and after World War I and II and other conflicts.



Figure 3.3 Australia is a multicultural society.

Our immigrants have introduced many different customs, foods and cultures into Australian society. Therefore we have encountered new products and innovations not seen previously, such as the electric wok.

Today, these rich influences from immigrants are evident in many areas of design, including architecture, fashion and landscaping.



Figure 3.4 The different cultures of immigrants have a considerable influence on many areas of society.

### Contemporary

It is important to celebrate past and present designers. The following examples of Australian designers represent various areas of design specialisation. The first case study explores the work of Aboriginal designer Lola Greeno, a well-known Australian jewellery designer who uses traditional production methods.

## CASE STUDY ANALYSIS 3.1

### Lola Greeno

**improvisation**

spontaneously acting on or creating something

Lola Greeno is a Tasmanian who combines the energy and **improvisation** of a **contemporary** arts practice with a tradition tracing back thousands of years. Born on Cape Barren Island in 1946, Greeno moved to Flinders Island and then Launceston in 1972. Greeno has continued the work of her mother and her mother's mother. She specialises in traditional Tasmanian Aboriginal shell necklace threading and today

her works are enjoying mainstream recognition, respect and demand.

Greeno is one of a handful of women shell-stringers responsible for ensuring the craft is passed from the Elders. Close personal connections between women have been essential in transmitting these skills and related values: 'I learned to make solely from working with my mother ... It was my mother who was

**contemporary**

belonging to or occurring in the present

very keen for us to work together and this has been the important cultural lesson I learnt from her – teaching respect for one another. My life has grown so much from my mother’ (Lola Greeno, discussion with the author, April 2004).

Greeno has dedicated *Purmaner*, 2004, to her mother Val MacSween, explaining that ‘*Purmaner* means my mother’. It is a dynamic work that reveals a familiarity with the dozen or so shell types from which distinctive patterns emerge. Greeno inherently understands the message each shell transmits. This string of iridescent maireener shells, yellow oat shells and stripy button shells, collected from the beaches of Flinders Island and mainland Tasmania, reflects an exuberant joy in practising culture.

Senior Tasmanian shell-workers are now working together with their own daughters or other family members to continue the skills of this practice. Greeno has described the imperative of passing on the tradition: ‘My future work is to teach my daughter and my grand-daughter to appreciate the significance of their cultural heritage by becoming the next generation of shell-makers. My dream is to see my daughter exhibit alongside of me’ (discussion with the author).

The National Gallery of Victoria first recognised the significance of this practice and the visual quality of the resulting works by collecting six necklaces in 1995 and now holds 10 necklaces in its growing collection of Tasmanian shell-work created by Joan Brown, June Brown, Corrie Fullard, Dulcie Greeno and Lola Greeno.

The maireener (*Phasianotrochus irisodontes*), a shell valued highly for its brilliant iridescence, is collected on correct tides from particular sea plants. The shells are cleaned, painstakingly sorted, then pierced and strung. The process can take from several months to a year, from collecting the shells to tying the final knot on a completed strand. Most shell-workers prefer creating with mixed shell types, where each strand carries its own specific aesthetic beauty, personal and cultural meaning and style identifiable to each maker.

Shell necklaces are markers of time-in-place for shell-workers. Shell types and the way they are strung signify how an individual

was working at a particular period and hence can assist in identifying necklaces with their makers. Each strand also reminds its maker when, where and why a necklace was made. Necklaces were and still are made as gifts and for trade – today this also includes the contemporary fine art market. Shell-work is fundamental to the makers’ lives, as Greeno explains: ‘My shell-making in my life is my whole cultural being ... I could not exist properly without making shell-work’ (discussion with the author).

Source: Dr Julie Gough, Curator of Indigenous Art, National Gallery of Victoria, 2004

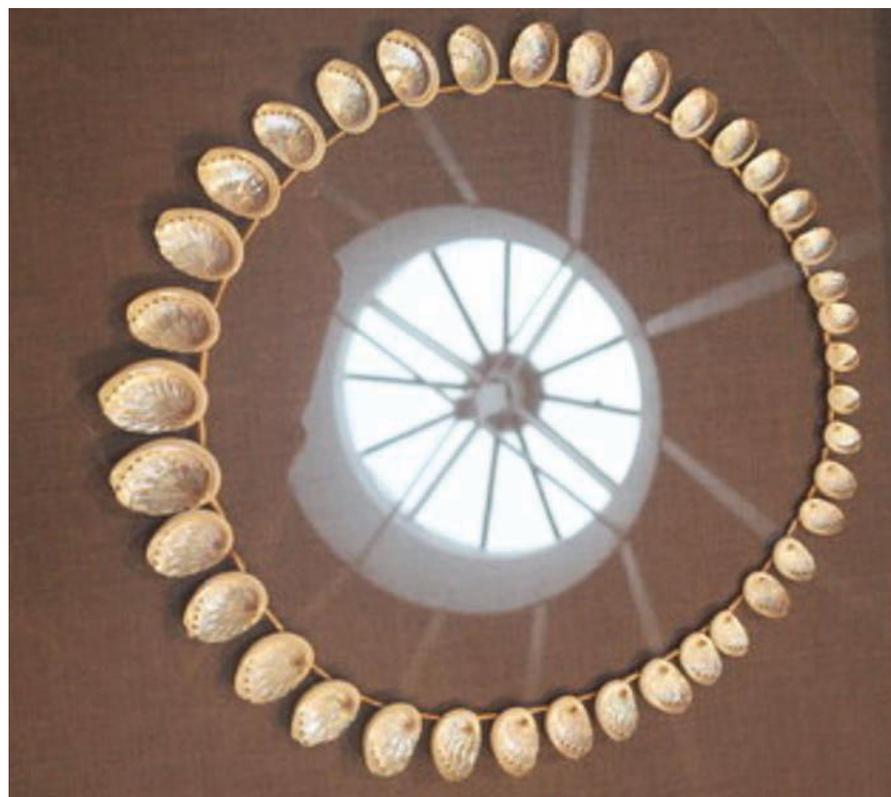


Figure 3.5 Lola Greeno creation from shells and echidna quills

- 1 Using a mind map, document the design processes that Lola Greeno works through in order to achieve finished products.
- 2 Describe how Greeno finds her inspiration.

## Marc Newson

Marc Newson has been described as the most influential designer of his generation. He has worked across a wide range of disciplines, creating everything from furniture and household objects to bicycles and cars, private and commercial aircraft, yachts, various architectural commissions, and signature sculptural pieces for clients across the globe.

Born in Sydney, Newson spent much of his childhood travelling in Europe and Asia. He started experimenting with furniture design as a student and, after graduation, was awarded a grant from the Australian Crafts Council with which he staged his first exhibition – featuring the Lockheed Lounge – a piece that has now, twenty years later, set three consecutive world records at auction.

Newson has lived and worked in Tokyo, Paris, and London where he is now based, and he continues to travel widely. His clients include a broad range of the best known

and most prestigious brands in the world – from manufacturing and technology to transportation, fashion and the luxury goods sector. Many of his designs have been a runaway success for his clients and have achieved the status of modern design icons. In addition to his core business, he has also founded and run a number of successful companies, including a fine watch brand and an aerospace design consultancy, and has also held senior management positions at client companies, including, at the time of writing, being the Creative Director of Qantas Airways.

Marc Newson was included in *Time* magazine's 100 Most Influential People in the World and has received numerous awards and distinctions. He was appointed the Royal Designer for Industry in the UK, received an honorary doctorate from Sydney University, holds Adjunct Professorships at Sydney College of the Arts and Hong Kong Polytechnic University, and most recently was created CBE by Her Majesty Queen Elizabeth II.

His work is present in many major museum collections, including the MoMA in New York, London's Design Museum and V&A, the Centre Georges Pompidou and the Vitra Design Museum. Having set numerous records at auction, Newson's work now accounts for almost 25 per cent of the total contemporary design art market.

- 1 In your own words, write out five of the steps in the process Marc Newson used to get to the final design of the Lockheed Lounge.
- 2 Describe why you believe Newson is a contemporary designer.



Figure 3.6 Marc Newson's Lockheed Lounge

## Impact of design on the individual, society and environment

As designers, we need to be aware of the impact that is associated with the design of products, systems and environments on the individual, society and the environment. It is extremely important that designers consider the positive and negative consequences of their work now and in the future, as the effects could potentially be far-reaching. Consideration must be made through both the design and production processes.

Designers often respond to community pressures and highlight their 'eco-friendliness' and **ethics**, which may also result in the work being more marketable.

A product, system or environment may impact on the individual, society and the environment. Some factors you may consider are:

- impacts on the individual and society (personal values, individual needs, cultural beliefs, equity, safety and health, economic factors, community needs, employment)
- ethical impacts (the consumer, advertisements, intellectual property, privacy, testing)
- environmental considerations (life-cycle analysis, pollution such as waste, landfill and noise, sustainability, energy, global warming).

In considering the impact a design may have on the individual, society and the environment, let's take one example and see what the potential impacts may be.

### ethics

moral principles that govern a person's behaviour or the conducting of an activity

Table 3.1 The advantages and disadvantages of Facebook

Advantages	Disadvantages
<b>To the individual</b>	
<ul style="list-style-type: none"> <li>• You can potentially contact users and be contacted 24 hours a day.</li> <li>• You can message people instantly.</li> <li>• You can control access to your personal information by deciding who sees what of your profile.</li> <li>• You can keep in touch with people you wouldn't otherwise be able to because of distance and time.</li> <li>• You can upload and share personal photographs and videos, as well as links to other sites.</li> <li>• You can express yourself by leaving comments on your 'status'.</li> <li>• You can keep up to date with news about your friends, their interests and relationships.</li> <li>• You can use the inbox provided for private conversations.</li> <li>• You can leave general, public comments on your wall.</li> <li>• You can play games with other users, or complete quizzes by yourself.</li> <li>• You can develop a large group of friends and contacts, with varied interests and expertise.</li> <li>• You can contact large groups of people at once to organise events or to gain support for a cause.</li> </ul>	<ul style="list-style-type: none"> <li>• Other users can try to contact you 24 hours a day.</li> <li>• You cannot control access to some personal information and photographs that other users put on the site.</li> <li>• You can be exposed to undesirable people or online predators.</li> <li>• As certain users can see some of your activities on the site, as well as photographs, you can lose your privacy.</li> <li>• As you can see the activities of other users on the site, you may develop social insecurities if your messages or 'friendship requests' are not replied to.</li> <li>• You can develop addictive behaviour, or dependence on the site. This may lead to loss of personal time, and the replacement of face-to-face relationships. It may also detract from study and work time.</li> <li>• You can become a victim of online bullying.</li> <li>• Other users can leave negative comments, upload inappropriate material or send abusive messages in private. (Bullying behaviour also extends to blocking, removing and isolating users, such as creating an event to which the victim is not invited.)</li> <li>• You may feel pressured to accept 'friends' with whom you would otherwise choose not to have contact.</li> </ul>

(continued)

Advantages	Disadvantages
<b>To society</b>	
<ul style="list-style-type: none"> <li>• Social and networking groups can be created quickly and cheaply.</li> <li>• Users with common interests are brought together.</li> <li>• Users in rural areas are able to participate in activities and access information they would otherwise be unable to.</li> <li>• Users have an effective means of mass communication.</li> <li>• Users may be able to communicate with others more often.</li> <li>• Users can be alerted, and alert others, in times of emergency.</li> <li>• Users are able to participate together in online activities and popular culture.</li> <li>• Businesses are able to directly target their demographic through advertising and marketing, and boost their online profile.</li> </ul>	<ul style="list-style-type: none"> <li>• Employers are able to spy on their employees, finding information about their weekend activities and relationships.</li> <li>• Users may be conditioned to use Facebook, which leads to changes in social behaviour and etiquette. Users may not develop interpersonal skills.</li> <li>• Users can have their accounts hacked and their personal data used for criminal activities. Status updates also alert potential burglars if users are on holiday or about recent purchases.</li> <li>• Children are at greater risk of grooming and attacks by online predators.</li> <li>• Some social groups promote racist, sexist, violent or other anti-social behaviour.</li> <li>• Users can violate intellectual property rights by uploading content that is not their own.</li> </ul>
<b>To the environment</b>	
<ul style="list-style-type: none"> <li>• Facebook is a communication means that does not require paper.</li> <li>• Environmental groups can be formed, and support for environmental causes rallied, quickly online with potential customers.</li> </ul>	<ul style="list-style-type: none"> <li>• Facebook uses a range of quickly developing technologies, such as computers and smartphones, which may encourage materialism, become obsolete quickly or add to landfill.</li> </ul>

### **ACTIVITY 3.1**

Ethical designers will think through the impact their design may have on the individual, society and the environment. In a table like the one shown, explain the cause and effect (impact) of each technology listed below for the individual, society and the environment.

- a car
- a new train system
- a laptop

	Cause (Why did this happen?)	Effect (What has happened as a result?)
Individual		
Society		
Environment		



## Contributions of males and females to design industries

We are all designers. Each day we explore possibilities and make decisions about what we will wear, how we will travel to our destination, how to organise our time for homework and sport, and what tactics to use to score points in a game. We work through a design process to reach a solution. This process will differ according to the situation but will have many things in common. We will always consider different ideas. We will develop our solution and we will evaluate throughout the process.

Both males and females have influenced the design world in their different ways. It is crucial that as a society we do not stereotype or pigeonhole a certain sex in a particular design industry.

### ACTIVITY 3.2

- 1 Write a one-page report on two influential designers.
- 2 Identify how they have incorporated past historical influences and culture in their designs.

## Career opportunities

Professional designers work in different ways. Some design in response to a need – personal or commercial. Some are inspired by a new material and envisage different uses for it. Others are employed by a client to design a product, system or environment for a specific purpose. A designer may also be part of a design team and be responsible for only one section of the final design.

From your study of Technology, you will be aware of areas of study within the context of designers. Some relevant areas of study are outlined next.

### Built environments

Environments are an important part of society. An environment heavily influences the way people live or behave. While some

environments are natural, they can also be created, modified or constructed. If someone's profession involves designing environments there are important factors to consider, including functional, physical and material properties, as well as aesthetic, ethical, environmental, socio-cultural, human form and scale, and safety requirements of the design. Some careers in built environments are:

- architectural design
- structural design
- interior design
- landscape design
- environmental design.

### Products

Products are consumed, used, purchased and distributed in large numbers every day. A product may be an object, system or artefact that has been designed and manufactured. The creation and sale of products are an important part of the economy. Products may be niche items or mass-produced. When designing a product there is a range of important factors to consider, including aesthetics, material properties, ergonomics, environmental, socio-cultural, safety and functional outcomes of the development. Some careers in designing products are:

- fashion design
- food design
- agricultural design
- jewellery design
- industrial design.

### Information and communications

Information and communications refers to various forms of data and information such as text, images, audio, video and statistics. The purpose of such data and information is to communicate a message. This communication involves using various forms of media, including verbal, written, graphical and digital, to access, process and transfer information and ideas. Audio and visual communication is as important as written and spoken communication. When a designer works with information and communications solutions, they consider the aesthetic, socio-cultural, ethical and functional outcomes of the design in careers that include:

- communications systems design
- information systems design
- promotional design
- digital media design
- software design.

## ACTIVITY 3.3

Research the following occupations, and copy and complete the table.

Design occupation	Job description/nature of work	Personal qualities
Architect		
Craftsperson		
Fine artist		
Fashion designer		
Graphic designer		
Industrial designer		
Interior designer		
Production designer		
Multimedia and web designer		
Photographer		
Digital visual effects		

### The work of past and current designers

It is important to investigate the work of designers across a range of settings. You need to research a variety of areas to have a greater understanding of the designers' work and how it affects what we do today.

Let's focus on jewellery design for a moment. Jewellery design is a form of product design.

#### Job description

Jewellery designers primarily design and create body adornments with a range of materials, including (but not limited to) gemstones, diamonds, silver and gold. Jewellery making is one of the oldest crafts and each piece can possess sentimental value and symbolic meaning. Designers must understand and relate to their clients so as to design the correct piece according to design specifications. In

addition to this, designers are expected to have mastered the practical skills needed to manufacture the piece.

#### Typical work activities

The nature of work for a jewellery designer includes:

- designing – using computer-aided design (CAD) to produce mock-ups and reference images of how a piece of jewellery may look
- mounting – manufacturing the framework for the piece of jewellery; this involves handling, forming and drilling metal, and opening out holes in which to place the selected gems
- stone setting – adjusting the mount to ensure the stones or other accents fit correctly; this can be very delicate work, as it requires removing tiny fractions of metal

- model making (casting) – creating an object or decorative detail using a mould; the mould can be made from a range of materials, including sculpted wax, plaster, metal or sand
- stamping and presswork
- chasing – creating a raised pattern on the surface of the metal
- electroplating – layering a precious metal onto a base metal
- enamelling – creating coloured patterns and pictures by fusing powdered glass to metal in a kiln
- welding – joining pieces of metal using traditional methods or by laser
- engraving – carving lettering or patterns into metals by hand or with computer-aided manufacture
- polishing – finishing off the piece by cleaning and polishing.

When a designer is employed by a company, a distinction is made between the design and the production. All the key responsibilities listed previously are delegated to various roles within the organisation.

Client-based activities differ from company-based ones. They may include:

- holding consultations with potential clients
- discussing a client's range of options and formulating original ideas
- sketching out ideas to help the client visualise the finished design.

Promoting the business and ensuring that it grows is essential for success as a jewellery designer.

Designers can increase their reach and popularity by networking, entering design competitions, managing a stall at a market or design fair, or producing original work to a high standard.

Jewellery designers may also spend time consulting with galleries, store buyers and suppliers, and researching the latest trends, other designs and the world of fashion to ensure their designs remain relevant.

## ACTIVITY 3.4

### 1 Cultural

African, Japanese, Incas of Peru, India, Pacific. Identify the types of adornment developed by the listed cultures. Do any of them hold special meaning or beliefs? Identify the tools and processes used to develop their adornment. How has the work of these cultural groups influenced the jewellery worn today?

### 2 Commercial

Stefano Canturi is a commercial designer. Examine the work he produces and describe how it differs from the work of designers like Lola Greeno. Investigate his techniques, materials, designs and finished products.

### 3 Industrial

Investigate the practices of industrial designers Amigo & Amigo. Why are Amigo & Amigo's products unique?

### 4 Historical

Investigate the materials, tools and techniques used by the Egyptians and/or the Romans in developing their jewellery items.

Yuri Kawanabe is a contemporary jewellery designer who works with interesting and unique materials. Using the internet, research Yuri Kawanabe or visit the web page <http://cambridge.edu.au/redirect?id=6610>.



Figure 3.7 A jewellery design by Yuri Kawanabe

- a Describe the important role aesthetics play in the designs of Yuri Kawanabe.
- b Describe why you would consider Yuri Kawanabe to be a contemporary designer. In your answer you should consider the designs, inspiration, processes, techniques, tools and materials that she employs.

### ACTIVITY 3.5

Examine and describe the work of current designers across a range of settings and from a range of focus areas of design. Research and report on three designers by answering the questions below. Designers may include Cheetah swimwear, Alice McCall, Milk and Honey, Tesla, Alec Issigonis and Ferdinand Porsche.

- 1 What are the names of the designers?
- 2 Describe the design specialisations.
- 3 What are the processes they go through in order to make their products?
- 4 What are their sources of inspiration?

## 3.2 Design and manufacturing careers

As outlined earlier, there are many roles that are available in both the design and manufacturing sectors.

### Careers in design and manufacture

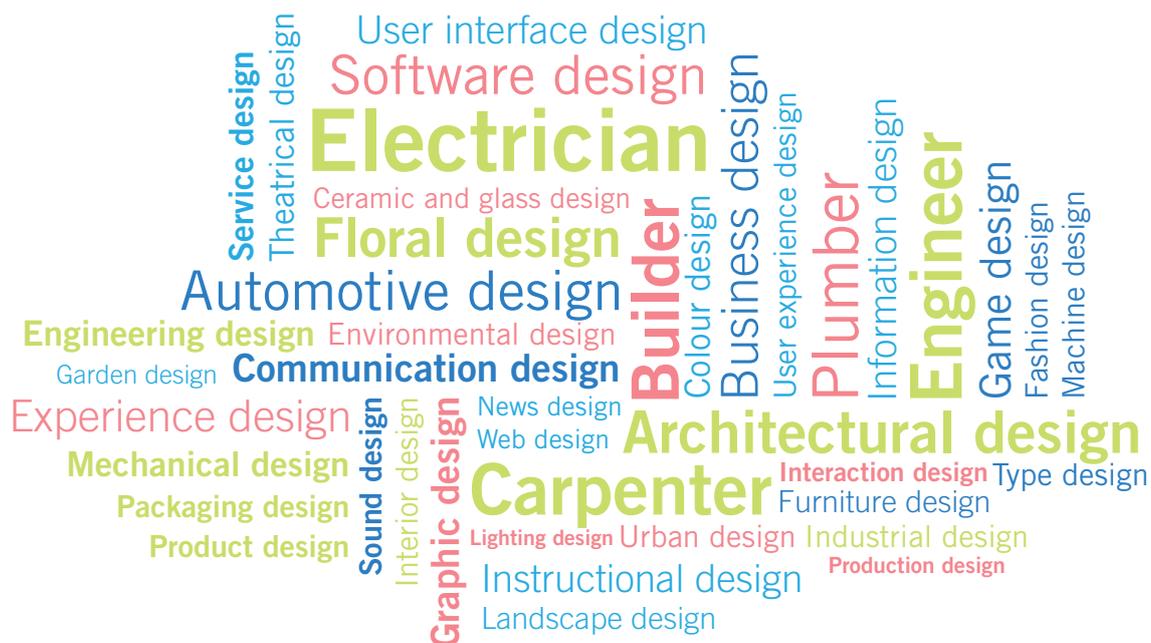


Figure 3.8 A wide range of career options exist in design and manufacturing.

#### ACTIVITY 3.6

Explore career opportunities and pathways in design and manufacture. Read through the employment section of a newspaper and collect the advertisements for five different positions for design professionals. Outline the various skills, traits and educational experience required for these five design jobs.

#### ACTIVITY 3.7

In a table like the one below, complete a summary on the designers profiled in this chapter or that you have studied in class. You may need to complete some other research.

Designer	Style	Inspiration	Materials	Career path

## Jai Vasicek



Figure 3.9 Work by contemporary designer Jai Vasicek

With a childhood spent sailing the world aboard his family's boat *Malachi*, the ocean runs in artist Jai Vasicek's veins and is a constant source of his creativity. His work draws inspiration from numerous cultures and bridges boundaries between classic and modern art and design, with stunning artworks, murals, paintings and textiles that evoke the beauty and passion of life and nature.

His designs feature vibrant colour with layers of print and patterns inspired by the sea and forest, with exotic creatures, feather and shell adornments, bold motifs, religious iconography and evocative female forms from Polynesian beauties to ocean sirens. Splashes of neon and bright colours and the raw textures of resins and grouting bring every piece to life, making them a truly unique style statement.

Jai's colourful crosses and wall tiles have become highly sought after, with an eclectic and expressive character that allows them to be displayed in groups or used as stand-alone decor pieces. Nowhere is his signature style more apparent than in his stunning large tiled wall murals; they dominate any space and can

be custom made to suit the client's personality and decor. Many of Australia's most stylish home decorators and savvy interior designers commission him to create one-of-a-kind artworks, making for a high-impact focal point in any room.

As well as selling into leading stores nationally and online, Jai has created his own little world in his popular Byron Bay store Ahoy Trader, where you can find a bowerbird's collection of his work alongside homewares and fashions from other local and Australian designers who share a similar aesthetic.

In demand, on trend and constantly evolving, Jai Vasicek is one of Australia's most exciting and collectable designers.

- 1 Draw the steps in the design process Jai Vasicek undertakes to develop his artwork.
- 2 You have been commissioned by Jai Vasicek to create a design that best represents your cultural context. Draw your design and describe how it meets the brief.

## ACTIVITY 3.8

Plan and prepare a report on non-traditional careers in design and technology. Select a non-traditional career and complete the following:

- 1 In approximately 150 words, describe the designer, referring to their work, designs and materials.
- 2 In approximately 100 words, justify how this designer inspires you; refer to their concepts and ideas and how you may take inspiration from them to utilise in your own work.
- 3 In approximately 100 words, name and describe the techniques, processes and materials the designer appears to use in the designing and production of their work.
- 4 Include at least two graphics (pictures or sketches) with annotations. Remember to reference your images.
- 5 Include a bibliography with at least five entries.



Figure 3.10 A colourful light installation during the Vivid Sydney festival, 2013.

## 3.3 Trends in technology and design

### Trends in history and contemporary cultures

As designers, it is important that we monitor trends. Keeping up to date with trends will ensure that designs meet the target market needs. It is also important to be aware of historical and cultural influences that have shaped design and production.

#### Trends

Social, cultural, global, political, economic and environmental influences directly and indirectly affect trends and in turn impact on design and production. Environmentally conscious design is an increasing trend in contemporary society. Companies such as Bird, a 'climate neutral' design company based in the Byron Bay hinterland, New South Wales, have strived to keep waste to a minimum while creating design solutions. Bird was founded by Rachel Bending, an ethical and environmentally conscious designer who saw the Bird brand as a means to create awareness about sustainability among consumers. Bending's designs include fabrics, fashion, gifts and homewares. These form a collection of 'luxury eco products for those who appreciate quality and style, and care about the planet on which they live'. Bird works 'towards sustainability' through a policy of reducing impact, reusing and recycling, using renewable resources and offsetting.

To support this eco-friendly philosophy, Bird uses innovative design and production processes. For example, the cloth prints central to the design range are handprinted using water-based and AZO chemical-free dyes. The printing process further reduces waste and run-off into waterways through heat fixing and a three-fold rinsing system. Fabric offcuts are used in gift and homewares designs and further scraps are recycled as buttons.

To read the story behind Bird and to learn more about this ethical business, visit the Australian Design Unit website at <http://cambridge.edu.au/redirect/?id=6611>.



Figure 3.11 Bird produces 'climate neutral' products.

#### Social issues

'Social issues' is an umbrella term that encompasses sub-topics such as multiculturalism, social class, egalitarianism and social conscience. As we consider each of these more closely, we will come to understand the importance and relevance of social trends and their impact on design and production.

#### Multiculturalism

A large percentage of Australians (or their parents) were born overseas. There are many cultures represented in our population. The trend to cater for our multicultural society has impacted on design and production activities. Although English is the national language, numerous other languages are spoken throughout the country. Instructions may need to be written in a number of languages. In the workplace, safety instructions are presented in graphical form so that workers of different nationalities can understand them. If you were designing a new school uniform, you may need to include clothing that respects the cultural requirements of traditional followers of a number of faiths. Multimedia products will sometimes have a warning that images of deceased people may be present, in respect of the beliefs of Aboriginal and Torres Strait Islander peoples.

#### Social class

A person's socio-economic status is determined by the interaction of their social and economic

situations. An implication of socio-economic status is the amount of disposable income an individual has. People in higher socio-economic groups have more funds to allocate to non-essential and luxury items. People in lower socio-economic groups have to allocate most of their funds to basic needs. Difficulties arise when there is social pressure to purchase products beyond a person's means. In some countries, class structure may be based on race or religion.

### Egalitarianism

Egalitarianism adheres to the principle of equal rights and opportunities for all. Minority groups, including people with disabilities, non-English speakers and underprivileged people, deserve products, systems and environments designed and produced to ensure that their needs are met and that they are accessible in both affordability and practicality. Not only must minority communities be catered for, but the impact on such communities of all products, systems and environments should be assessed to ensure no further marginalisation is created.

### Social conscience

Social conscience refers to values; to individuals' and society's sense of right and wrong in reference to the well-being of the society and community. Individuals, depending on their social, environmental and political persuasion, support different causes and some seek to ensure that they remain on the social agenda. Sometimes groups in society have moral or ethical opposition to some innovations (such as cloning). It is helpful for designers to be aware of this, and to assess the ethicality of their design.

### Globalisation

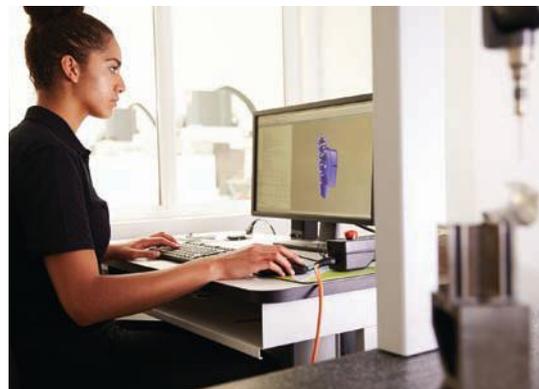
**Globalisation** is often described as the process of the world becoming a smaller place. Designers are both affected by and contribute to that process. Technological advancements have created easier, quicker access to distant or remote places, making trade, communication and travel much easier. Satellite communication via phone, fax, email and even online conferences provides faster and simpler means of communication between nations. Teams in different countries can undertake design and production projects cooperatively.

### Technology

As discussed in previous chapters, technological change has had a vast historical and cultural influence on design and production. We can trace that change from times when production was completed with basic tools and equipment, and every product was made by hand. The Industrial Revolution, and the later introduction of assembly-line manufacturing, allowed designers to increase their production output. The digital revolution of the last two decades has increased that output, and reduced the costs and time in which production is completed.

Technological change has not only impacted on production, but also on the way in which designers work. Until recently, office workers were required to be physically present at their workplace five days a week. Information and communications technologies (ICT) permit working from home or other locations. These technologies allow instant contact between colleagues, even if they are time zones apart. Technological change has had an impact on virtually every aspect of our modern lives.

Many designers have embraced technological change in their work, and all designers need to be aware of its impact.



**Figure 3.12** Designers need to embrace the changes introduced by technology. Technology can cut costs, increase productivity and improve the quality of work.

## ACTIVITY 3.9

Identify how ICT applications used by designers have impacted on their work. Be specific in your response.

**globalisation**  
the process of economic, financial and cultural interaction and integration around the world

## Chapter summary

- All products, systems and environments impact on the individual, society and the environment throughout the production and design stages.
- Factors such as personal values, cultural beliefs, sustainability, safety and health, community needs, individual needs and equity all impact the way in which a product, system or environment is designed and produced.
- Designers' works impact on the individual, society and the environment.
- Individual and societal impacts include:
  - personal values
  - cultural beliefs
  - safety and health
  - community needs
  - individual needs
  - equity
  - economic factors
  - employment.
- Ethical considerations include:
  - impact on the consumer
  - protection of intellectual property
  - advertising of designs
  - change in natural order
  - privacy
  - animal testing
  - exposure to undesirable people
  - minority groups.
- Environmental considerations include:
  - life-cycle analysis
  - landfill
  - energy consumption
  - recycling, using sustainable materials
  - waste disposal
  - pollution, noise, air, water, etc.
  - ozone layer
  - renewable/non-renewable energy sources.
- We must all work towards using ecologically friendly devices in the home, school and workplace.
- Industries must work towards reducing their impact on the environment.

## Define key terminology

- 1 Cultures
- 2 Environment
- 3 Historical
- 4 Migration
- 5 Trends

## Chapter summary tasks

- 1 Construct a mind map to show the impact that the internet has had on individuals, society and the environment.
- 2 Outline how designers ensure that they are considering the environmental impact of their designs.
- 3 Describe how new technologies have improved the way in which designers can communicate their design ideas to the clients.
- 4 You are a product designer and have been given the following brief: Design and produce a lightweight, all-weather jacket to be worn at a local co-educational primary school.
  - a List and describe the main design issues and the constraints to be considered before designing the jacket.
  - b Sketch the front and back views of your initial idea and clearly label the design features.
  - c Explain three features that address the issues and constraints listed in the brief.
- 5 Describe how the design trend of globalisation has impacted the way in which we communicate.
- 6 As a contemporary designer, it is important that you are aware of the consequences of using particular materials in your designs. Research plastic as a material and the consequences of using that material.
- 7 Discuss the importance of not stereotyping designers into specific roles.

- 8 Evaluate the consequences of immigration on Australian society.
- 9 Describe three design jobs that are available in the built environment design specialisation.
- 10 Analyse the effects of one of your design projects on the individual, society and the environment.

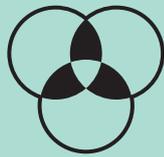
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## Extension tasks

- 1 Visit 'The House That Mike and Heather Built' at <http://cambridge.edu.au/redirect/?id=6612>. Prepare a report describing how Mike and Heather save water and electricity in their home. Discuss how an average Australian can save water and electricity in their home.
- 2 Visit 'Australia Innovates' on the Powerhouse Museum website (see <http://cambridge.edu.au/redirect/?id=6613>). Choose three innovations that you think address social issues. Evaluate the design and production processes used in these innovations.

# 4

## The work and responsibility of designers



### Key terminology

Contemporary  
Environment  
Society

This chapter explores how designers consider the factors affecting their work in designing and producing. Designers need to ensure that they have analysed how these factors impact the final end product, system or environment. Planning for these factors ensures that the final product, system or environment will be successful.

In order to develop a clear understanding of the content of this chapter, carefully examine the 'Students learn about ...' and the 'Students learn to ...' statements relating to **Outcome 5.3.1** in the New South Wales *Design and Technology Years 7–10 Syllabus*.

## 4.1 Design purpose and setting factors



Figure 4.1 Fashion designers also consider the factors affecting design.

### Factors affecting a holistic approach

When designing, there are a number of factors that will affect the outcome of the final product and production. It is important that designers consider these factors before they begin designing their product.

As designers, we need to ensure that we think about how we will respond to each factor and address it.

Not all factors relate to a particular design, and factors can be ranked. For example, if you were selecting your formal dress, aesthetics might be the first factor you would consider, followed by cost; whereas in selecting a kettle you might consider functionality first, then aesthetics and cost.

When you are analysing the factors affecting design, you must consider how each factor affects the design of your project and/or production of your project.

### Function

Function refers to how well a product, system or environment works. It is vital that the intended design meets the brief and its intended outcome.



Figure 4.2 The design of a kettle must satisfy its functions.

Some questions to consider are:

- For what reason is the product being made?
- Who will use it?
- Does it suit the user's age and abilities?
- When will it be used?
- Is it suitable for use during the intended time of year or day?
- How often will it be used?
- Does it need to be cleaned regularly?
- Is it durable or does it need extra care?
- Where will it be used?
- Is it suitable for use in a specific location?

### Form

Form refers to the shape, appearance or **configuration** of an object. We know that products may not just be seen as functional. Take the example of a toaster. We have seen recent collaboration with industrial designers and artists in developing toaster designs.

Some questions to consider are:

- How will the shape and function of your product, system or environment affect the form of the design?
- Consider the proportion of your design. Do you want it to appear heavy and solid or light and delicate? How will this affect your designing of the product?



Figure 4.3 Marc Newson collaboration with Sunbeam. Function, form and aesthetics were considered when designing these items.

### Aesthetics

Aesthetics refers to the 'beauty' and appearance of a product, system or environment.

Some questions to consider are:

- Will the user expect the product to look a certain way?
- Does the method of decoration technique suit the overall end product?
- Do the colours suit the product?
- Should the decoration act as a point of focus, or should it mask an unattractive base design?
- Can the decoration be placed at structural points to strengthen the design?
- Will the decoration stay in place?

### End-user aspirations and context

Designers must always keep the end-user in mind in the development and production of their designs.

Some questions to consider are:

- Does it meet the needs of the target market?
- Does it suit the environment context?

### Historical, contemporary and future considerations

Taking into account the historical, contemporary and future considerations when designing is important. This may involve demonstrating how your design has been influenced by current and past materials, tools or techniques as well as considering what possibilities may be achieved with future technologies and innovations.

Some questions to consider are:

- Has the design been influenced by past techniques, materials or design periods?
- Will advancements in materials, tools or techniques refine the design?

### Quality

Quality refers to a design or finished product that not only meets its specifications but also delivers the best value for money in terms of performance, finish and reliability. Quality may refer to strength, durability, reliability or ease of use.

Some questions to consider are:

- How will the selection of materials, choice of components, choice of construction processes, level of finish and the way in

**configuration**  
the arrangement  
of elements in a  
particular form,  
figure or combination

which design elements are combined affect the quality of your design?

- What is the expected life of your product? How will this factor affect the designing and producing of your product, system or environment? What will you need to consider?

### Trends

Social, cultural, global, political, economic and environmental influences directly and indirectly

affect trends and in turn impact on design and production. When developing your design, consideration of trends is vital.

Some questions to consider are:

- How will my design impact on society?
- Is my design culturally sensitive?
- Is my design economically viable?
- Have I considered the design's environmental impact in both the design and production stages?

## ACTIVITY 4.1

You have been commissioned to design a new school uniform.

- 1 Sketch your design and label each feature with the techniques, materials and key design features.
- 2 Identify and describe how the factors affecting design have been considered. Draw on specific examples.



Figure 4.4 A typical Australian school uniform

## ACTIVITY 4.2

Analyse and report on the factors that affect the decisions taken in the development of design ideas and solutions for one design project you have undertaken. When reporting back, ensure you provide specific examples showing how you have addressed these issues in the design and production process.

## 4.2 Human, technical and environmental factors

### human capital

the skills and knowledge embodied in the ability to perform labour to produce economic value or a final design and product

### Human capital

**Human capital** refers to the skills and knowledge embodied in the ability to perform labour, so as to produce economic value or a final design and product. You will need to consider how your knowledge of adornment and the processes involved in the development of adornment pieces will influence your final design and product.

A skill is the learned capacity of talent required in order to carry out predetermined results, often with minimum output of time and/or energy. Skills can often be divided into types:

- domain-general skills
- domain-specific skills.

Examples of domain-general skills include time management, teamwork, collaboration and motivation. Domain-specific skills include those skills that are specific to a certain environment or subject area. For example, in jewellery the skills needed for successful development of a project include project management, development and realisation of ideas, cutting, soldering, buffing and polishing.

Some questions to consider are:

- What are the domain-general skills and domain-specific skills you will use throughout the development of your project?
- How will the factors domain-general skills and domain-specific skills affect the development of your design, the processes used, production and the finished product?

### Techniques

Techniques can be either functional or aesthetic. An example of a functional technique is a butt join. An aesthetic technique may include staining. Whatever the technique,

forward planning is required in the design and production plan. A clear indication of the role of each technique is vital.

Some questions to consider are:

- For what reason is the product being made?
- Who will use it?
- What techniques will I use?
- Which techniques will provide an aesthetic aspect?
- Which techniques will assist in the function of the design?

### Ergonomics

The relationship between the user and the end design is important. Designers need to consider how end-users will interact with the design and need to address this factor in order to ensure that the design is functional.

Some questions to consider are:

- How will **ergonomics** affect your design? Why must you consider this?
- Do you need to consider a range of alternative body shapes and sizes?
- Does it need to fit snug against the body?
- Should you make it so it is adjustable to suit a number of sizes?
- Does your design consider a range of ages and female versus male? How will these traits affect your design?
- Describe the relationship between you as the designer and the tools, techniques and materials that you use throughout the production process. What ergonomic considerations do you need to take into account?

### Safety, values and ethics

#### Safety

Safety in relation to designing and producing refers to:

### ergonomics

understanding of the activity of humans within systems or in an environment to maximise the well-being of humans and their productive use of those systems or environments

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- the safe use of tools, materials and techniques during all stages of the design process
- the designer's legislative responsibility for the safety of the design projects they develop
- health and safety in handling, use and storage of materials
- health and safety in the use of techniques
- legislative requirements.

Some questions to consider are:

- How will safety affect your design and the production of your design?
- What must you consider and why?
- What will be the effects of materials, tools and techniques during experimentation and production?
- Are there any safety issues that might affect the end-user? Describe how these could be limited, reduced or removed.

### Personal values

Personal values evolve from situations that we experience throughout our life and can change over time. Values can be shaped by culture, religion, politics, personal experiences, family and friends. Values can be related to the 'norm' of society, which broadly looks at rules for behaviour for specific situations. Values identify what should be judged as good or bad, right or wrong, desirable or undesirable.

Some questions to consider are:

- How will your values affect the materials, processes, research methods and techniques that you use in the development of your design and production?
- What are your beliefs about what should happen to your product when it is no longer in use – recycle, reuse, end up in landfill? How will this affect your choice of materials?

### Ethics

Ethics is a major area of philosophy that encompasses the right conduct and a good life. It is also known as analysing right and wrong behaviours, acts and processes. Recently there has been much discussion about ethical

design, processes, materials, techniques and final products, systems and environments.

Consider the effect that ethics has on the selection of processes, materials and techniques for your project.

## Industrial and workplace legislation

Designers must consider the requirements of the law. The *Trade Practices Act 1974* aims to ensure that the consumer is protected in the aspects of the product quality and service, including product safety. The *Patents Act 1990* and copyright laws protect the designer and the product designs from imitation and copying.

Some questions to consider are:

- How does legislation affect your designing and producing?
- Why is it important to abide by laws, particularly for the designer and the end-user?
- Which legislation do you need to abide by? Why?
- Discuss the implications for employers and employees if laws are not abided by.

## Appropriateness of technology choices and design decisions

Designers must consider the technology that they will use in the development of a design. Technology impacts on the quality of finish, production plan and possible choices of techniques.

Some questions to consider are:

- What is the purpose of the design?
- Who will benefit from using this product?
- What are the tools or techniques that I will be using throughout the process?

## Social and environmental sustainability

### Social

Designers need to consider who will be the end-user of their product. Making sure that the product meets the needs of the client ensures that the design is long-lasting and viable.



Some questions to consider are:

- Will people like it?
- Will the age group for which it is intended like it?
- Will the age group who will be buying it, such as parents, like it?
- Does it conform to societal values and beliefs? Does it meet cultural expectations?
- Is it easy to promote and sell?

### Environment

Morally, designers need to consider the impact their design will have during production, during its use and after its use. Designers need to consider the following factors prior to production.

Some questions to consider are:

- Will the making of the product cause pollution?
- Where will this pollution go?
- Does the product require packaging? If so, what type of packaging is required?
- How can packaging be kept to a minimum?
- Does the method of decoration pose any health risks? For example, is toxic glue or paint needed?
- When the product is used, does it create any problem fumes or sounds?
- What are the resource choices and availability (e.g. tools, materials, time, finance)?

## 🔍 CASE STUDY ANALYSIS 4.1

### Making of a BMW car

Watch the 'BMW Car Design Process' video on YouTube (see <http://cambridge.edu.au/redirect/?id=6614>) and read the case study below.

The product development process for a new model extends over a period of some five years and is divided into three phases.

It starts with the company commissioning a design for a new automobile. Adrian van Hooydonk, Senior Vice President BMW Group Design, and his interdisciplinary team jointly draw up a briefing for everyone involved in the design process.

This conceptual framework gives the designers, developers and engineers the greatest possible creative scope for designing the new car.

#### Fundamentals

At the start of the initial project phase, the critical attributes are laid down. Based on these, the designers then produce the first proportional models for the new vehicle.

Determining the proportions is a highly important aspect of the design process. As with any product, perfect proportions are seen as the key to aesthetics and harmony.



Figure 4.5 Concept sketches are fundamental at the start of a project phase.

The designers start out by drawing the silhouette and the characteristic lines of the incipient vehicle.

After the initial sketches they produce so-called tape drawings on a package plan – a kind of grid map of the vehicle on a 1:1 scale and including all its technical and structural constituents.

Using flexible tape, the designers attach the main proportional lines onto the package to accentuate them.

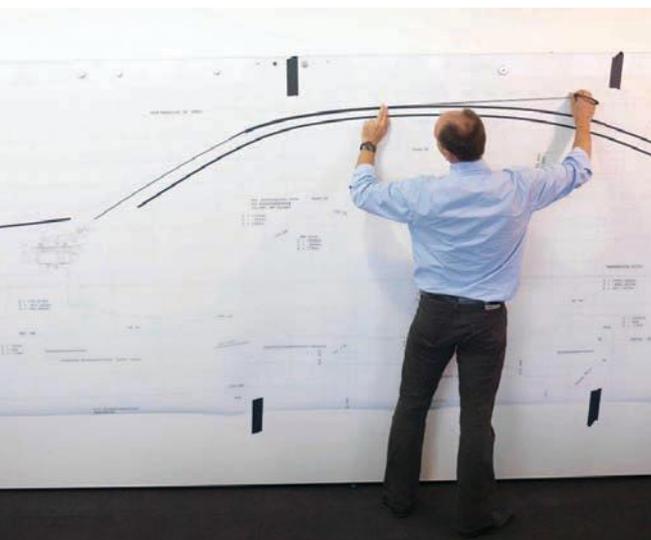


Figure 4.6 A tape drawing of a car

In the finished tape drawing, the silhouette and contours already convey the character of the completed vehicle. In the ensuing dialogue between the designer and CAD modeller a virtual 3D proportional model of the new car is created.

The aim of this first phase is to gain a mutual understanding of all the factors influencing a proposed design and their impact on it.

Already, at this early stage, key components such as the wheelbase, luggage compartment volume, range of engines, interior width and safety stipulations are fixed as part of the design brief.

At this point, a closely integrated design–technology convergence is essential since all the available technical innovations must be implemented in a way which the ultimate user will experience as functionally perfect, expedient and visually compelling.

### Phase 2: Competition

A key aspect of the form-finding process for BMW Group Design – and unique within the motor industry – is the internal, highly creative contest for the design of the exterior and interior of a vehicle, in which the designers compete against one another.

The entire Exterior and Interior Design team under the baton of the relevant head of design develops its diverse ideas through sketches and virtual representations, which are then rendered as three-dimensional physical clay models.



Figure 4.7 A 3D physical clay model featured in the internal design contest held by BMW

In adherence to the agreed proportions, the distinctive design language of each particular concept then emerges.

The brief is to create innovative design drafts and highly aesthetic proportions and surfaces.

The work on clay models is very time- and cost-intensive. Only a few car manufacturers place so much value on 1:1 models made of clay – a special type used by designers – and refine them in such faithful detail.

Covering the model in a special foil that resembles Titanium Silver Metallic paintwork allows the lines, surfaces and proportions of each model to be realistically assessed in varying light conditions.



Figure 4.8 The car model is covered with a special foil before assessment.

Clay models allow for the continuous development of the design since any desired modification can be rapidly implemented and realistically visualised on the 1:1 model.

During this phase the number of clay models is gradually whittled down based on decisions by the Board of Management.

As part of the process, the designers' image of the perfect appearance of the exterior and interior of the new model takes on a definitive shape.



Figure 4.9 The interior of a car model

The ultimate decision as to which design will be implemented is made around three years before the scheduled production launch in a final showdown between two contenders.

For one – potentially very young – designer, this special moment means his or her design has won the contest and will be turned into reality.

### Phase 3: Detail work

Once the final design proposal has been selected by the Board of Management, it is time for precision work on the details that are crucially important to the series development process.

For this phase, BMW Group Design has lined up a special Detail Design team whose task is to fine-tune all the exterior and interior elements to a state of design perfection.



Figure 4.10 Laser scanning is used to transform the model into a 3D reference.

Extremely close coordination between the designers, engineers and manufacturing specialists also forms part of this phase, aimed at the precise definition of each individual detail down to hundredths of millimetres.

In this way the BMW Group ensures that every product lives up to its premium claim – from surface quality right down to the micro-level.

Only then is the sculpture which was perfected by human hand transformed into a product capable of being reproduced by machine.

In a CAD (computer-aided design) process, laser scanning turns the model into a three-dimensional feasibility model; that is, a technical reference model for all further developments.



Figure 4.11 Virtual technologies are implemented during the development process.

In parallel with this, various **virtual technologies** are specifically employed to optimise efficiency in the development process and ensure precision in execution.

During this phase, the designers intensely turn their attention to those aspects which the eventual owner will experience when using the vehicle and which will guarantee its enduring fascination, even after many years.

Adrian van Hooydonk, Senior Vice President BMW Group Design, explains: 'In the design process I aim to coax the maximum creativity from my team. That is why I keep the briefings as open as possible. Every single designer is

invited to deliver their own take on the brand or the relevant project, in words and images. My job is then to select the best of the numerous opinions and proposals. For me that's one of the most exciting moments in the entire design process.'

**virtual technologies**  
technologies used in the creation of a virtual (rather than actual) version of something

- 1 Describe the design process that the BMW designers undertake.
- 2 Discuss which factors affecting design they consider when developing a new design.
- 3 Analyse how they address social and environmental issues in their new designs.

## Resource choices and availability

Resources are fundamental to a successful design. Prior to starting on a project, designers need to ensure the availability of such resources. Tools, materials, time and finance are just some of the resources designers use. Without consideration of these, designs may not be completed on time or incorrect materials may be used, which could potentially be very costly.

### Tools

Tools can be hand or powered tools. They are any items that assist in the production of a design. Designers need to consider which tools they will use, as the choice of tools will impact on the final techniques used in their design and also on the finance, time and action plan. Careful planning is required when considering the tools to use.

### Materials

Designers consider availability and properties (weight, strength, hardness, look, feel) of materials as well as the facilities available for development. The working properties of the materials and the ability of the manufacturer must be considered. The durability of the product will be influenced by the properties, process and quality of the materials.

Some questions to consider are:

- How will the physical properties of the material affect your design?
- What is the impact of cost in relation to materials? How does this affect the

designing and development of your design?

- How will cost of materials affect the development of your design and the production of your design?

Durability refers to whether the design will last for its designed life in the situation or environment for which it has been designed. For example, the product may fail due to prolonged stress, poor workmanship, inferior raw materials and poor original design.



Figure 4.12 Factors such as the materials used and the overall design can contribute to the durability of a product.

Some questions to consider are:

- What must my product do to achieve its intended purpose?
- What is the life of my product?

### Time

Time is one of the most important resources, and it will influence the quality of the final design. Careful planning and managing of this resource is required. Designers manage this by creating a time and action plan.

Some questions to consider are:

- How will time impact on the tools, materials and techniques you use?
- How will your design need to be modified because of the time constraints?

### Finance

Development and production costs must be considered. The designer must justify the investment made. If the product is too expensive to make, it is likely to be too expensive for the consumer. Labour costs are a consideration. If a product takes too long to develop, the labour cost will be high.

Some questions to consider are:

- How will the cost affect your design/product?
- Will the cost of materials or tools affect the design/production?
- Will the product be affordable to all consumers?
- What are the ethical implications of pricing, sales and distribution? How will these affect your design?

## ACTIVITY 4.3

Describe factors affecting the design and production of design ideas and solutions in the following areas. Provide examples to support your response.

- 1 fashion design
- 2 interior design
- 3 graphic design
- 4 game design
- 5 industrial design



Figure 4.13 Game designer

## 4.3 Creativity and problem-solving techniques

There are a number of different ways in which designers demonstrate their creativity and their ideas. Most designers will initially start their ideas development by either brainstorming or creating a mind map to help with getting their ideas on paper.

Cognitive organisers are simple ways that designers record their creativity and ideas. They may include:

- brainstorm lists – listing possible ideas, solutions, tools, techniques and materials
- mind maps – writing down a central idea and thinking up new and related ideas that radiate out from the centre
- concept boards – presenting key themes and illustrations on a board.

### Needs and opportunity analysis

In identifying your opportunity for new and better solutions, it is important that you are aware that your project does not have to be something ‘brand new’. In many design projects, the designer may have used their knowledge of existing materials, techniques and processes to modify their design.

Your design brief will be the first step in your design process, yet when you are attempting to solve a problem that you have encountered you will need to identify the needs of the user first. Therefore identifying a need will really be your first step.

### SWOT analysis

Designers may complete a SWOT analysis of their needs. A SWOT analysis looks at the strengths and weaknesses internally, and then looks at the opportunities and threats externally.

Think about these factors in terms of one of your design products. What are some internal and external factors that may impact on the development of your design? Think of factors such as time, finance, skills, resources available and materials.

Table 4.1 SWOT analysis table

<b>Internal</b>	Strengths	Weaknesses
	•	•
	•	•
	•	•
<b>External</b>	Opportunities	Threats
	•	•
	•	•
	•	•

### Constraints analysis

Part of the needs analysis involves looking at what may impact or hamper the design process. This is known as constraints analysis. What could potentially impact the design process? Constraints may be factors such as budget, time and skill level.

### Collaboration and research and exploration

Working through the design process can at times involve working with others. This is known as collaboration. Working with others ultimately allows for a better final design. Designers work with experts in that particular area, taking advantage of their skills and knowledge.

Researching and exploring the best possible design ideas, tools, techniques and materials ensures that the final design is of the highest quality. A designer should not cut corners in this area. Knowing what is out on the market, and how to select and execute the best tools, materials and techniques, makes for a successful design.

## Vedel's Child's Chair

Danish industrial designer Kristian Solmer Vedel saw the need for multifunctional furniture for young children.

Kristian Vedel was one of the first architects who took children's furniture seriously and designed furniture in a simple, modern style, but still created for the needs of the child. The Child's Chair is not just a copy of 'grown-up' furniture, but a unique creation taking as its point of departure the various ways a child can move and use the furniture for playing as well as sitting. The adjustable child's chair is a semi-circular bent plywood form, with horizontal cut-outs to accommodate adjustable pieces of laminated plywood. The adjustable pieces are held in place by tension, resulting in a perfect design for a child's chair, without using any screws, nails or bolts. Vedel's chair can be arranged in various configurations, depending on whether a chair, table or high chair is desired.

'My purpose was to create a combination of a child's chair and a tumble stool, appealing to the children's own fantasy and their varying psychological and physical needs. A tool, to support single as well as group of children, which in size, form, weight and character, fits as many situations and ages as possible.' (Kristian Vedel, 1999)

In other words, Vedel designed a chair that is useful in different situations during a child's upbringing – from when a child can crawl, sit and stand up until the child walks. Even as an adult, the chair, which you might grow up with, can serve as a stool or as a side table, and then be carried on to the next generation.

- 1 Outline why this product is successful.
- 2 Identify and describe the factors the designer needed to consider.
- 3 Describe the potential creativity and problem-solving techniques used by the designer in his work.



Figure 4.14 The Child's Chair is versatile and modern while still suitable for children.

### Playsam



Playsam creates innovative and timeless wooden toys for the young and young at heart. The aim is to engage those individuals who welcome a visual challenge, demand superb quality and crave intellectual creativity – in short, lovers of excellent Scandinavian design.

- 1 As a class, debate the following statement: 'Children today would rather play computerised games than play with more traditional toys.'
- 2 You have been commissioned to create a simple toy to add to the Playsam line. This toy will be made out of wood and designed for girls. Draw and annotate your solutions.

Figure 4.15 Playsam's success is based on simple and elegant designs.

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## Chapter summary

- Designers must ensure that the factors affecting design and production are considered prior to the commencement of designing and producing.
- Designers must always keep in mind the end-user in the development and production of their designs.
- Social, cultural, global, political, economic and environmental influences directly and indirectly affect trends and in turn impact on design and production. When developing your design, consideration of trends is vital.
- Working through the design process can at times involve working with others. This is known as collaboration.
- Design and production costs must be considered. The designer must justify the investment made.
- Researching and exploring the best possible design ideas, tools, techniques and materials ensures that the final design is of the highest quality.
- All designers work through a design process.
- Careful planning and managing of time is required. Designers manage this by creating a time and action plan.
- Ergonomics is the relationship between the human and the end design, and is very important.
- Resources are fundamental to a successful design. Prior to starting on a project, designers need to ensure the availability of resources.

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## Define key terminology

- 1 Contemporary
- 2 Environment
- 3 Society

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## Chapter summary tasks

- 1 Describe how form and function impact the design of a toy.
- 2 Discuss why aesthetics may not always be an important factor to consider.
- 3 Describe functional and aesthetic requirements when developing a new garment for the teenage market.
- 4 Outline the importance of ergonomics when developing a new school desk.
- 5 Complete a SWOT analysis of a design brief that you are completing this year.
- 6 'Time should not be considered a resource.' Discuss this statement.
- 7 Describe how designers use creative solutions to document their design process.
- 8 Discuss how technology has impacted the global environment.
- 9 Describe the functional and aesthetic techniques that you have used in a recent project.
- 10 Discuss how historical factors have impacted on the design of the toaster.

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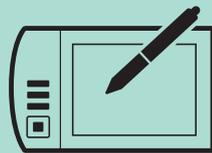
## Extension tasks

- 1 'Collaboration is not necessary in design.' Discuss this statement.
- 2 Research the new Barangaroo precinct (see <http://cambridge.edu.au/redirect/?id=6615>). Analyse how the following factors have impacted on the development of the Barangaroo site:

- function
- form
- aesthetics
- end-user aspirations and context
- time – historical, contemporary and future considerations
- quality
- trends.

# 5

## Appropriate technology and ethical and responsible design



### Key terminology

**Appropriate technology**  
**Design issues**  
**Design solutions**  
**Emerging technologies**  
**Environment**  
**Innovation**  
**Principles**  
**Responsible design**  
**Society**  
**Trends in design**

This chapter explores the concept of appropriate technology, involving the idea that consumers have needs and understand those needs better than anyone and can therefore suggest or invent the technological innovations necessary to meet those needs. It also looks at ethical and responsible design, involving the study of moral dilemmas in designing. The chapter covers concepts such as ethical and responsible design in a design focus area and how designers respond ethically and responsibly to design issues and appropriate technology when they develop design ideas and solutions. It also discusses issues relating to ethical and responsible design and explains the need for ethical, responsible design and appropriate technology when developing design ideas and solutions.

In order to develop a clear understanding of the content of this chapter, carefully examine the ‘Students learn about ...’ and the ‘Students learn to ...’ statements relating to **Outcome 5.3.2** in the New South Wales *Design and Technology Years 7–10 Syllabus*.

## 5.1 Ethical and responsible design

### Ethics and responsibilities

Ethics involves learning what is right or wrong, and then doing the morally right thing. Good design should be aesthetically pleasing and ethical because it will not only enable the user to enjoy the product but will also ensure that the product will not cause any harm. Realistically it is hard to find design that incorporates both elements. There are some common themes that come from studying design and ethics, such as:

- personal ethics – what type of designer do you want to be?
- discrimination – gender or race
- anti-consumerism – persuasive techniques
- ethical theories – applied and pure
- user safety – user responsibility and misuse
- social/environmental sustainability – obsolescence and life-cycle
- consumerism – security and privacy
- manufacture – sweat shops, deskilling workforce and hazardous materials
- intellectual property and liability.

**society** a body of individuals living as members of a community

**principle** an accepted or professed rule of action or conduct

**responsible design** in which social, environmental, moral or ethical considerations inform the design

**appropriate technology** encompassing technological choice and application that is small scale

### Ethical, responsible design and appropriate technology

Designing must progress from servicing the needs of business to servicing the needs of **society**, particularly those communities in developing economies and countries that account for more than 80 per cent of the world's population. It is imperative that all global communities have access to basic essential elements of life, such as clean drinking water, energy, sanitation, health care, education and the tools for self-determination. Skills in designing must be balanced with social awareness, environmental sensitivity and cultural sensitivity. The next generation of engineers, designers and innovators must be responsible practitioners who are critically aware of the potential impact of their professional activities, conscious of the contribution that design can make to the quality of life in global communities. Designers who responsibly, ethically and appropriately design with tools, wisdom and expertise can succeed and be effective designers.

New directions in design must be led by students, through integrating the **principles** of sustainable design and socially **responsible design** throughout the learning process and focus on designing for a need rather than market agendas, to achieve the necessary change.

Many global societies lack the necessary resources for well-being, health care and education, and are denied the tools for freedom. Some communities are in need of solutions to problems of sustainable energy production, sanitation, water supply, disease prevention, shelter, clean and efficient cooking, and communication, and need permanent alternatives to ongoing humanitarian aid. While we as designers are not the instruments of these problems, it is the responsibility of the designer/engineer/innovator to lead change that addresses these issues. This contributes to the main reason why we need ethical, responsible design and **appropriate technology** when developing design ideas and solutions.



Figure 5.1 Ethics are an essential part of responsible design.

These substantial and complex problems need holistic solutions that are not product-focused, but people-focused, locally focused and co-designed. It is estimated that approximately 80 per cent of all product-related environmental impacts are determined during the design stage, whether that be through material specification, manufacturing processes, transport or packaging requirements or resource consumption.

Consequently, product design teams and design students must not only be conversant with the potential negative impact of their design decisions from environmental, social, cultural and economic aspects, but also be sufficiently skilled and knowledgeable to navigate these difficult decision-making processes to achieve appropriate, sustainable product solutions.

## ACTIVITY 5.1



Figure 5.2 The *Hoodia gordonii* cactus used by the Kalahari San bushmen

*Hoodia gordonii* is a succulent plant native to Namibia and South Africa. *Hoodia* has been used for centuries by the San tribespeople of Namibia to treat a range of health conditions, including tuberculosis, abdominal cramps, indigestion, haemorrhoids and diabetes. In recent years, *hoodia* has been the object of significant media coverage after several natural supplement companies ran marketing campaigns claiming that *hoodia* could be used as a natural appetite suppressant leading to weight loss.

The active ingredient in *hoodia*, called P57 (glycoside), was isolated in 1977 by the South African Council for Scientific and Industrial Research (CSIR). The CSIR later granted a licence to the pharmaceutical companies Phytofarm and Pfizer to research synthesising P57 with a view to developing an appetite suppressant that could be produced in commercial quantities.

In 2002, the CSIR reached a revenue-sharing agreement with the San tribespeople over rights to *Hoodia gordonii*, with the CSIR officially recognising the San's traditional knowledge of the plant. Since *hoodia* is a protected plant, only individuals and a select few companies are allowed to harvest it.

Discuss the ethical issues that could arise from a large pharmaceutical company using a minority group's cactus for weight loss and appetite suppressants.

**innovation**  
something new or  
different introduced

## Innovation

**Innovation** can be defined as a new idea or invention that has been converted to a product or service that solves a specific problem or customer need.

Innovation is the process of utilising research, creativity and risk-taking to develop new products or services that are considered valuable. It involves turning new ideas into solutions to customer needs. Innovation is inherently risky; new products and technologies require new markets, and many ideas that may be considered new and radical in themselves fail commercially because they do not reach a potential market. A framework for defining innovation and determining the value of an idea therefore needs to include a focus on market needs as well as things like creativity and progressiveness. Designers strive for innovation. They work towards using their creativity to solve problems in new ways and come up with ideas that are as valuable as they are radical.



**Figure 5.3** Designers use their creativity to come up with ideas for products and services that solve problems and drive progress.

### Types of innovation

Innovation is often very subjective (based on people's opinions). Despite its subjective nature, there has been some useful research into thinking about what innovation is and how it works.

The '4Ps' model developed by John Bessant and Joe Tidd provides a powerful tool for looking at successful innovation and lists four types where such change can take place:

- 1 'Product innovation' – changes in products and services.
- 2 'Process innovation' – changes in the ways in which products and services are created or delivered.
- 3 'Position innovation' – changes in the context in which the products and services are communicated.
- 4 'Paradigm innovation' – changes in the underlying models that shape what the organisation does.

#### *Product innovation*

Product innovation is probably the most familiar form of innovation. It involves introducing a new product or service, or improving an existing one, to better serve customer needs. One such innovation is the Bic ballpoint pen, which has undergone many design improvements since its introduction after World War II.

#### *Process innovation*

Process innovation is a form of innovation that involves achieving the same goal in a different, more efficient way through the use of new technology, equipment or software. Process innovation is usually driven by the need to cut costs and deliver goods and services to larger numbers of people. A famous example of process innovation is Henry Ford's use of the assembly line in the early twentieth century.

#### *Position innovation*

In contrast to product and process innovation, position innovation involves a change in how an existing product or process is perceived. One example is Levi Strauss jeans. Jeans were initially conceived as workwear for male factory workers and labourers, but over time have undergone a variety of shifts in perception to the point where their original conception may be one of the last things we think of when we think of jeans.

#### *Paradigm innovation*

The final form of innovation refers to a change in the underlying pattern of thought, or 'mental model', of a business or organisation (or any group of people). An example of paradigm

innovation is low-cost airlines. Formerly, airlines were companies that catered for those who could afford the high price of passenger tickets and generally provided quite lavish service. A low-cost airline company cuts out all the 'fancy' things and gives the consumer what they need at a reasonable price. By giving the customer what they need, the airline can eliminate what is undesirable and build a whole new market.

### Examples of innovation

When judging if a product is innovative, it is worthwhile considering a variety of factors. Some of these may include:

- Does it address a concern that was previously problematic and is now resolved?
- Does it perhaps open up new markets, or is it just a really good idea?
- Does it improve the quality of life for the intended users?

Two examples of innovative ideas are discussed below.

#### *Spider silk for use in the military*



Figure 5.4 Ultra-strong spider silk

When you were growing up, did you ever stare at the intricate design of a spider web, amazed at the detail in it? Researchers at Polytechnique Montréal used the idea behind this natural wonder to produce an ultra-tough polymer fibre based on the structure of spider silk. It is sturdier than steel and finely configured, but its extraordinary strength is due to the molecular structure of its protein chain. This spider silk

can be used in a variety of ways, such as protective clothing for soldiers and for aircraft or motor vehicle parts.

#### *Rapid prototyping*



Figure 5.5 3D printing example

Rapid prototyping refers to the production of models and prototypes from 3D computer-aided design (CAD) data using 3D printing. Rapid prototyping is considered an innovation because it is a disruptive technology at the crossroads of manufacturing and cutting-edge 3D design. It puts advanced printing improvements (and their profit potential) directly in the hands of small businesses and home-based digital manufacturers. For many, it is like the second Industrial Revolution.

Rapid prototyping lets you create, print and sell customised objects – both simple and complex – without having to depend on expensive processes or the logistical delays and expenses involved in dealing with large companies.

Anyone with a computer, free 3D software and a 3D printer can create their own designs. Innovations are being made in printer technology to support a wide variety of materials, such as plastic, wax, ceramic, alumide, sandstone and even metals such as silver and aluminium. This boosts the scope of the kinds of objects you can create with a 3D printer.

Today, 3D innovators are developing creations in bold new fields such as home building, medical equipment, biomedical engineering, automotive design, rocket design and Hollywood special effects models.

## Biomass smokeless stove



Figure 5.6 Biomass pellets used in a smokeless biomass stove

Biomass fuel, or biofuel, is renewable organic material produced from or by living or recently living plants and animals. Examples are wood, peat, charcoal, vegetable oil and animal waste. One-third of the world's population uses such fuel domestically for heating, cooking and lighting. If insufficient air reaches the fuel, it undergoes incomplete combustion, meaning that it does not release all its heat, and pollutants are discharged into the home. These pollutants are associated with respiratory and cardiovascular diseases, low birthweight and other health issues.

The biomass cooking stove has air vents that ensure enough oxygen reaches the wood fuel to make combustion complete. The pollutants burn up as well, yielding even more heat. The heat is also concentrated in the right space for cooking, below the cooking pot. The stove has insulated walls to reduce heat loss. Through these features it has twice the fuel efficiency of traditional stoves. It may also be fitted with a chimney that draws the flue gases and the minimal amount of pollutants above the air being breathed by the cooks, or even to the outside.

In addition to domestic use, the biomass smokeless stove can replace stoves used in smaller food outlets and street and market food stalls in India and Africa.

The advantages of the biomass smokeless stove are that it:

- reduces indoor air pollution and its associated health problems
- has more efficient combustion of the fuel, maximising heat energy yielded
- has lower fuel consumption for the same amount of cooking, saving on cost of fuel and reducing the environmental impact of fuelwood and charcoal production (e.g. deforestation)
- is cheap to make and sell, priced at \$US5–7.00
- is durable, with parts that can easily be replaced
- is portable: it can be carried by one person
- can be fitted with a chimney to keep flue gases away from the cooks
- fits in with existing cooking practices and domestic settings, being about the same size as the inefficient stoves it replaces.

- 1 Name some benefits this stove could have for developing countries.
- 2 List some influences the biomass stove would have on developing countries.
- 3 Describe the characteristics, features and components that make the biomass stove an innovation.
- 4 Analyse, with the aid of examples, the impact that this innovation would have on the lifestyle of the people in developing countries.
- 5 Analyse the social, cultural and economic effects that this innovation has or could have on developing nations.
- 6 What might be some of the limitations to and parameters of the more widespread use of this innovation in developing countries?

## Past, current and emerging technologies and innovations

In this section, two innovations and **emerging technologies** are identified. The range of focus areas consists of communication systems, environmental, fashion, accessory, software, industrial and information systems.



Figure 5.7 Gesture recognition being used

### Gesture recognition

Gesture recognition by computing devices involves analysing features of a person that identify them, and/or analysing any action or movement they perform. This requires an input device: a sensor that makes a 3D digitised 'map' of the movement, or a camera to input an image or video. Secondly, it requires software to analyse the input and interpret it as a command. Human features used to identify people include finger and palm prints, faces, voices and irises. Movements include eye tracking and lip movements as well as arm and hand gestures, collectively called kinesics. This system as a whole is called a perceptual user interface (PUI), and its purpose is to enhance the useability of software, making computer-human interaction efficient and more natural.

PUIs available for games, fitness and dance applications include the Wii Remote Plus, Xbox Kinect and PlayStation Camera. Sci-fi movies such as *Minority Report* and *Iron Man 2* show

a future where computers are controlled by a wave of the hand, which is becoming a reality. Gesture recognition allows computers to be more accessible for the physically impaired, but it can be applied much more widely.

Movement sensors for PUI input use accelerometers in hand-held or wearable devices to measure how far the device moves compared with fixed points and directions. Cameras may be 2D, but stereoscopic or multi-angle cameras will create more detailed 3D images.

The social aspects of gesture recognition need consideration in addition to the technical challenges. Gestures should be simple, natural, not easily confused, and acceptable across a wide range of people and cultures in the intended market.

### Wearable fitness devices

The innovative colourful wristband in Figure 5.8 shows how many steps taken, calories burned, kilometres walked and what a person has achieved over the course of a day. Running can be tracked via GPS or the accelerometer tracks when running indoors. Keen golfers can access up to 38 000 course maps, scorecards and the ability to measure distances using GPS. Also a swimming app counts lengths, tracks pace and distance and determines your swimming efficiency score. It comes with the colour LCD screen or band and can last up to three weeks in watch/activity mode. That drops to 10 hours when the GPS is used. It also connects via Bluetooth to receive notifications from a smartphone.



Figure 5.8 A wearable fitness device

**emerging technologies** new technologies that are currently developing or will be developed and that will substantially alter the business and social environment

There is a saying that if you can imagine something, then it can happen. Movies often depict future beings with digital tattoos or internal microchips, and this may come to fruition eventually. Researchers are constantly innovating. At Echo Labs, in Palo Alto, California, a biometric band that can measure your blood pressure, oxygen, hydration and so on is being developed. The wristband measures the reflection of varying light frequencies to reveal the concentration of molecules in the blood by shining electromagnetic waves through the body.

## ACTIVITY 5.2

For a design to be successful and innovative, it must provide a solution. Innovative design ideas and solutions should also have data or analysis to support the desired outcomes.

‘Design is the action of bringing something new and desired into existence – a proactive stance that resolves or dissolves problematic situations by design. It is a compound of routine, adaptive and design expertise brought to bear on complex dynamic situations.’

– Harold Nelson

Characteristics of being innovative and enterprising involve five points:

- finding simplicity in complexity
- including beauty as well as functionality
- improving quality for society’s experiences
- creating sophisticated solutions
- serving the needs of the consumers.

‘When design principles are applied to innovation, the success rate for innovation dramatically improves.’ In a 400-word essay, discuss this statement, providing examples to aid your discussion.

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## The impact of past, current and emerging technologies

Technology has been impacting people’s lives dramatically with every new development since the mid-twentieth century.

## Past technologies

One of the earliest pieces of technology was the calculator. In 1642, Blaise Pascal invented a mechanical calculator that worked using gears and could only add and subtract. Pascal’s invention would eventually lead to the development, in 1971, of the microprocessor, which is now used in all calculators and computers.

In 1837, Charles Babbage, together with Ada Lovelace, proposed the Analytical Engine – a mechanical general-purpose computer. It used punched cards, had a calculator and a storage unit that could hold 1000 figures of 50 digits each. However, it was never built. The first electronic digital computer, the Colossus, was built over 100 years later, in 1943. Three years later, the ENIAC (Electronic Numerical Integrator and Calculator) was built. Both of these early computers are very different from computers today: the Colossus was programmed with plugs and switches, and the ENIAC was so large it took up an entire room. It was 30 metres long, 3 metres high and weighed over 27 000 kilograms.

Many of the characteristics we take for granted with today’s computers, such as fast processors, larger storage, portability and anywhere accessibility, began to be introduced in the 1990s. The World Wide Web (WWW) was conceived in the 1980s and was introduced to the world in 1991.

The internet offered new and exciting ways of doing things. For example, communicating with people could now be done via email. File transfer became easier and increasingly common. Businesses and workplaces developed infrastructures that allowed them to provide goods and services online, and e-commerce started to emerge.

## Current and emerging technologies

Technological convergence is the current trend in emerging technologies. Technological convergence is when several different technologies or functions are merged into one device or piece of equipment, making them cheaper and smaller. Smartphones, tablets and smart televisions are all examples of this. A smartphone combines functions that can be performed by singular devices such as telephones, address books, cameras, GPS systems, media players and web browsers. Because smartphones can access the internet,

they can also be used for email, social media, digital calendars and a range of other functions. The ability to stay connected on the go with powerful computers and wireless

connectivity has allowed greater freedom for the user, and has changed the way individuals, businesses and society interact and behave. It has also impacted our environment.



Figure 5.9 Will Corning Glass be widely used in our future?

### ACTIVITY 5.3

We are living in an amazing time period in which technology is changing how we live. Watch 'A Day Made of Glass 2: Unpacked. The Story behind Corning's Vision' (2012) on YouTube (see <http://cambridge.edu.au/redirect/?id=6616>). Write a 500-word essay explaining how this emerging technology would impact individuals, society and the environment.

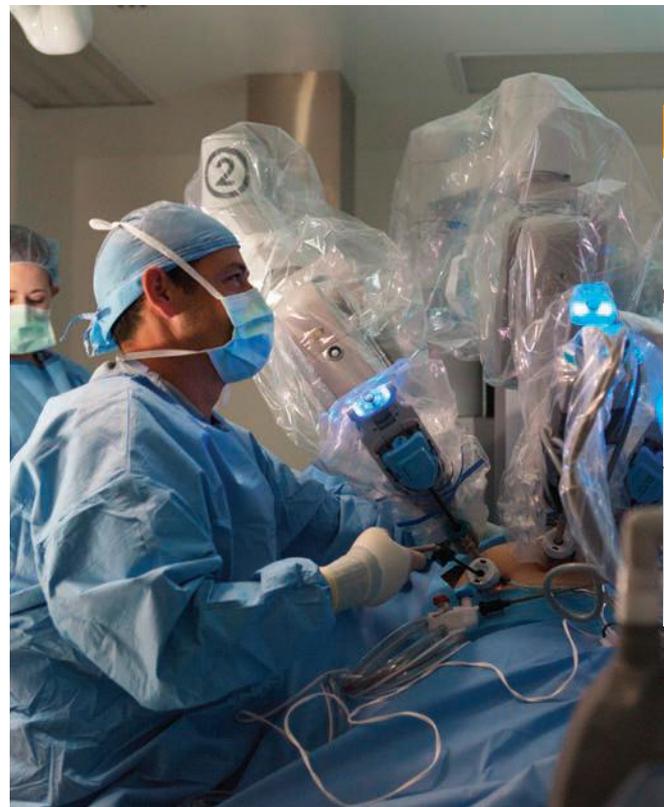
## 5.2 Design issues and appropriate technology

Appropriate technology involves ensuring that technologies fit within the context for which they were designed. This may include biophysical contexts, such as health, climate and the environment, as well as psychosocial contexts, such as politics, economics and religion. Using appropriate technologies can have a significant impact on society by increasing efficiency and the standard of living.

Determining the appropriateness of technology can be done through evaluation, understanding the design criteria and having a grasp of the issues of design. Design issues will vary depending on the project. However, there are some issues that need to be considered for each project. These include:

- **Safety:** Understand the safety requirements of the work you are completing, not just for the users of the end product but also your own safety when using heavy machinery or dangerous tools. Familiarise yourself with the *Work Health and Safety Act 2011* to understand the rights and responsibilities of employers and employees in the workplace.
- **Ethics:** As discussed at the beginning of the chapter, ethics generally refers to a personal code of conduct based on beliefs, values and society. As a designer, you need to consider any ethical issues related to your project. Ask yourself if your product is benefiting society. Is it damaging any parts of society? Be aware of the impact your design will have on the target market and any other external stakeholders. Your personal ethics will also influence the choices you make as you work on your design. For example, you may be drawn to a certain project because it is a project you are passionate about pursuing.
- **The environment:** Wastage and pollution are major issues in the modern world. Mass production can have long-term

consequences for the environment due to the overuse of resources and excessive waste. Designers can help to minimise the impact of production by sourcing sustainable materials, working with environmentally conscious companies and selecting processes that will not harm the environment.



**Figure 5.10** The use of robotics in the medical industry has been revolutionary, although its use comes with many issues, safety being one of the main concerns.

### Issues relating to ethical and responsible design

Designers have responsibilities to uphold when designing products, systems or environments. Three main responsibilities are ethics, honesty and environmental responsibility. Ethics plays an important part in the design profession. For example:

- Software, hardware, and others' intellectual property: Designers should respect the beliefs and intellectual property of their clients. Licences in software and the 'code of practice and conduct' for organisations should be strictly adhered to. Designers should not take on work or clients they believe have questionable ethics. Certain behaviours and standards should be upheld.
- Bias, accuracy and privacy of data: Data can be collected in a number of

different ways. Bias can be present when there are poorly designed survey questions. Errors can be made when performing data entry. Privacy of data must be ensured, as people expect the information to be used and handled with care. Unethical behaviour and inappropriate use of data include selling the details of the data to another party. A more extreme example is hacking. This is an illegal form of access to data when it is not authorised.

## 🔍 CASE STUDY ANALYSIS 5.2

### 3D printing helps with life-changing medical procedures



Figure 5.11 A prosthetic limb that has been scanned and recreated in a 3D printer

3D printing still holds a lot of unfulfilled potential. Talk abounds of disrupting manufacturing, changing the face of construction and even building metal components in space. While it is hard not to get a little bit excited by these potentially world-changing advances, there is one domain where 3D printing is already having a real-life impact. Its capacity to produce customised implants and medical devices tailored specifically to a patient's anatomy has seen it open up all kinds of possibilities in the field of medicine. The following information discusses three significant, life-changing procedures made possible by 3D printing technology.

#### A titanium heel implant

Len Chandler, a 71-year-old man from Melbourne, Australia, was faced with amputation below the knee after doctors diagnosed him with cancer in the heel bone. In exhausting all options, the surgeons had also been working with experts from the Commonwealth Scientific and Industrial Research Organisation (CSIRO), exploring the possibility of producing a 3D-printed implant to save the patient's lower leg.

Using schematics of the heel bone, a titanium implant was printed and inserted into Chandler's foot. Three months later, he was said to be recovering well and able to place some weight on his heel again.



Figure 5.12 3D-printed titanium bone implants

### A 3D-printed hip implant

The doctors of a 15-year-old Swedish girl suffering from a congenital disease resulting in skeletal deformations in the left hip were uncertain about whether she would walk again. But they then approached an implant manufacturing company called Mobelife to see what options might be available.

Mobelife used a tomography scan to create a detailed picture of the patient's unique bone anatomy, ultimately printing an implant that would be secured with screws to the bone surrounding the defect. The operation was performed and 18 months later she was walking entirely unaided.

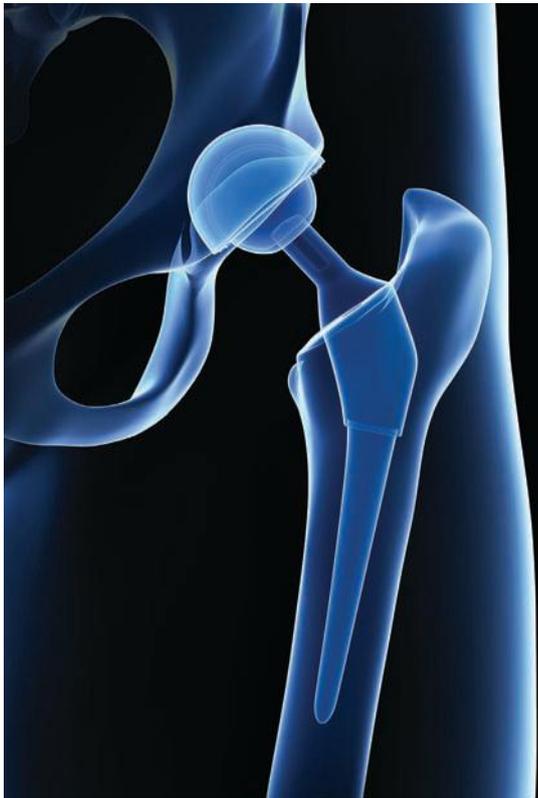


Figure 5.13 A 3D-printed hip implant

### Planning for complex heart surgery

When surgeons were approached by the parents of a 14-month-old boy born with four heart defects, they knew they had a task on their hands. But in planning for this surgery, they would be afforded the help of an invaluable new-age medical tool.

Using CT scans of the baby's heart, researchers were able to print a 3D model of the organ, measuring 1.5 times its actual size.

This process took around 20 hours and cost US\$600, but gave the doctors unprecedented opportunity to plan prior to a heart surgery, seeing them repair the heart's defects in a single operation. Following his release from hospital, the boy was said to be in good health.

These are no doubt just the tip of the iceberg in terms of the benefits 3D printing will bring to the field of medicine in the coming years.



Figure 5.14 Heart surgery

- 1 Identify some ethical issues relating to this emerging technology.
- 2 Explain how the designers may respond ethically and responsibly to this innovation.
- 3 Analyse how cultural and social factors determine the success of this innovation.
- 4 Write a 400-word essay about whether this emerging technology is an appropriate technology.

## Impact of technologies

The easy availability and improvement of technology has changed the way people and businesses work. New technology has many positive impacts on individuals, society and our environment.

### Individual

Technologies such as mobile phones, email, video calling, conferencing and text messaging have made staying in touch with family and friends around the world easier and much cheaper. People are also able to get news from around the world with a touch of a button, thanks to live and up-to-date internet reports.

Jobs that are important to society have also made use of new technologies to improve the quality of the goods and services they provide. Teachers, for example, use technology to improve learning in the classroom and make homework easier. Doctors use the latest medical technology to accurately diagnose people and give the correct medications and treatments to help them live. Farmers use specialised IT equipment to keep track of their produce to make sure we have enough to eat. Businesses are switching to digital, using less paper to save our forests from logging.

But although new technologies can have very positive impacts on people's day-to-day lives, they can also have negative impacts. While technology can increase productivity and stream work flows, it can also lead to staff redundancies. For example, when automated teller machines (ATMs) were first introduced in 1967, they made some aspects of banking easier, faster and more accessible; however, they reduced the number of jobs available to bank tellers. Also, some older people found the technology difficult to use and preferred a more face-to-face service.



Figure 5.16 Technology has changed the way people interact.



Figure 5.15 ATMs have streamlined the way we all bank and access money.

## Society

With the rise of broadband internet, social networking websites and apps, smartphones and other forms of communication technology, we have never had more tools with which to communicate and connect with others all around the world, whether they are family or strangers, from our own or a different culture. However, it could be argued that the use of these technologies has not made us more social. Being connected to the rest of the world via social media and smartphones may possibly leave us feeling more lonely, stressed and isolated from the rest of the world. Technology has made some of us question what it means to be social and form meaningful relationships with others.

We are undoubtedly at the beginning (or in the middle) of a social revolution. Defining appropriate and ethical social behaviour when it comes to our digital interaction will become increasingly important. Communication technology is developing at an accelerating pace – faster, it seems, than we have been able to think carefully about what these developments mean for us.



Figure 5.17 Technology and today's society

## Environments

New technology has not only improved trade and commerce; a large part of industry is directed at reversing the negative effects humans have had on the environment.

Green technology can be found in many new homes, creating better solutions for energy in the home. Solar panels harness UV rays to create sustainable energy, and kinetic powers such as wind and water currents can produce electricity, which has decreased the demand for coal and fossil fuels.

In the past, technological innovations were designed with little concern for the long-term consequences they would have on the environment. Greenhouse gas emissions from such creations have caused global warming. The gas emissions build up in the atmosphere and penetrate the Earth's ozone layer, causing melting glaciers, rising sea levels, air pollution, ocean acidification, disrupted marine and wildlife biodiversity, groundwater contamination and soil depletion.

Green technology aims to improve the state of the Earth and in turn improve the health and well-being of the world's population. Overuse of wood burning and coal in China has caused widespread pollution and resulted in an alarming amount of respiratory disease. China is ranked as the country with the highest record of fatalities by asthma sufferers by the Asia Asthma Development Board. Shockingly, it is expected that of 100 000 Chinese citizens who suffer from respiratory diseases, 36.6 per cent of cases will be fatal.



Figure 5.18 Technology and today's environment

## 5.3 Preferred futures

Today's society is very different from the one your parents or even your older brother or sister grew up in. The introduction of technology such as smartphones, fitness trackers, tablets and gaming consoles has helped to shape the way we live our lives in the twenty-first century. Today it is hard to imagine life without this technology, whereas in the past it may have been hard to imagine life with it. Design and technology play an important role in shaping the future. Designers are required to imagine a future that does not exist yet. This is a concept known as preferred futures and some people have even made predicting the direction of the future their career.

In design and technology, preferred futures relates to the development of long-term visions or outcomes that will benefit nations, companies, communities and individuals by helping them to achieve sustainable prosperity in a globalised world. A preferred future is carefully thought out, researched

and evaluated in order to shape communities locally and globally. However, not all preferred futures are achievable; some may need resources that have not yet been invented.

### Visions for preferred futures in design and technology

#### Vision 1

The world of medicine is constantly changing and technology is an integral part of the industry. Medical breakthroughs have allowed life expectancies to increase drastically and diseases that were previously a death sentence can now be managed in effective ways. One new medical technology that is at the forefront of the industry is regenerative medicine. This technology will fight diseases such as diabetes, help with organ failure and fight the effects of ageing. It also has the potential to produce fully functional organs that can be transplanted.



Figure 5.19 Technological change

## Vision 2

You may not realise it, but sensors are a large part of people's day-to-day activities. On average, people carry approximately 11 different sensors. The more sensors are used by us, the more potential they possess. At the moment, sensors are found mostly in our phones and tablets, but these same sensors could one day be seen in your bathroom mirror, displaying your body temperature and heart rate. Perhaps in the future these sensors could determine the state of your health; they may be able to warn you when the flu is coming on, so you know to stay home from school and rest. You could use this technology to have a doctor's certificate sent straight to your school. The next decade will be revolutionary for monitoring and managing our health and well-being. With the use of technology and mobile devices, we are recording more information about ourselves than ever before.

It is already starting to happen with devices such as Fitbit Charge, Nike FuelBand and Jawbone Up. But more complex health-monitoring systems are on the way. There are companies with these technologies almost ready to launch.

## Vision 3

You may be aware of wearable technology. Interactive glasses and fitness trackers have been available on the market for quite some time. Currently, some companies are trying to take wearable technology to the next level with bionic, data-rich and in-body technologies that may change what it means to be human. A company called Athos is planning to launch fitness clothes that measure your muscle activity, heart rate and respiration in real time. The purpose behind the clothing is to help humans become the ideal versions of themselves, putting their health and their abilities as their main priority. Popular brand Levi Strauss is also exploring this transhumanist approach to clothing with garments that interact with your devices. Touch-sensitive surfaces will make it possible for garments to monitor weight and muscle gain, and even allow you to make phone calls without touching your phone.



Figure 5.20 Levi Strauss is developing touch-sensitive jeans.

## ACTIVITY 5.4

- 1 Identify what changes will occur in society to achieve a particular vision (choose Vision 1, 2 or 3).
- 2 Discuss five advantages and five disadvantages of Levi Strauss's new technological garments.
- 3 Explain a vision of your own.
- 4 Refer to Vision 1. What could this new medical technology mean for society?

## ACTIVITY 5.5

- 1 Identify specific examples of preferred futures in the armed forces.
- 2 Describe two occasions when you have had to justify your design as a designer at school.
- 3 Identify five points that make a 'great' designer.
- 4 Explain the reluctance that designers might have in justifying their design decisions.

## Predicting future directions for design solutions

Problem solving is a fundamental part of design and technology. New problems arise each day and, through innovative and creative thinking, design solutions are being created not only by designers but also by people in fields that are not related to design thinking. With technology that is so accessible to certain parts of the world, more people are given the opportunity to create and deliver design solutions to different people. It is anticipated that this will increase in the future. People who may not necessarily have a background in design may be exposed to problems that are new and in need of a solution.

When trying to picture the future of design solutions, we need to consider three design principles: integration (of systems and information), interaction (of people, systems and services) and independence (of people and performance). The advancement of technology plays a large role in these principles. Technology is becoming increasingly integrated into our lives, and more and more people are beginning to understand the potential. Technology is also allowing for increased collaboration. Typical barriers that may restrict who and what we interact with are



Figure 5.21 Designer at work

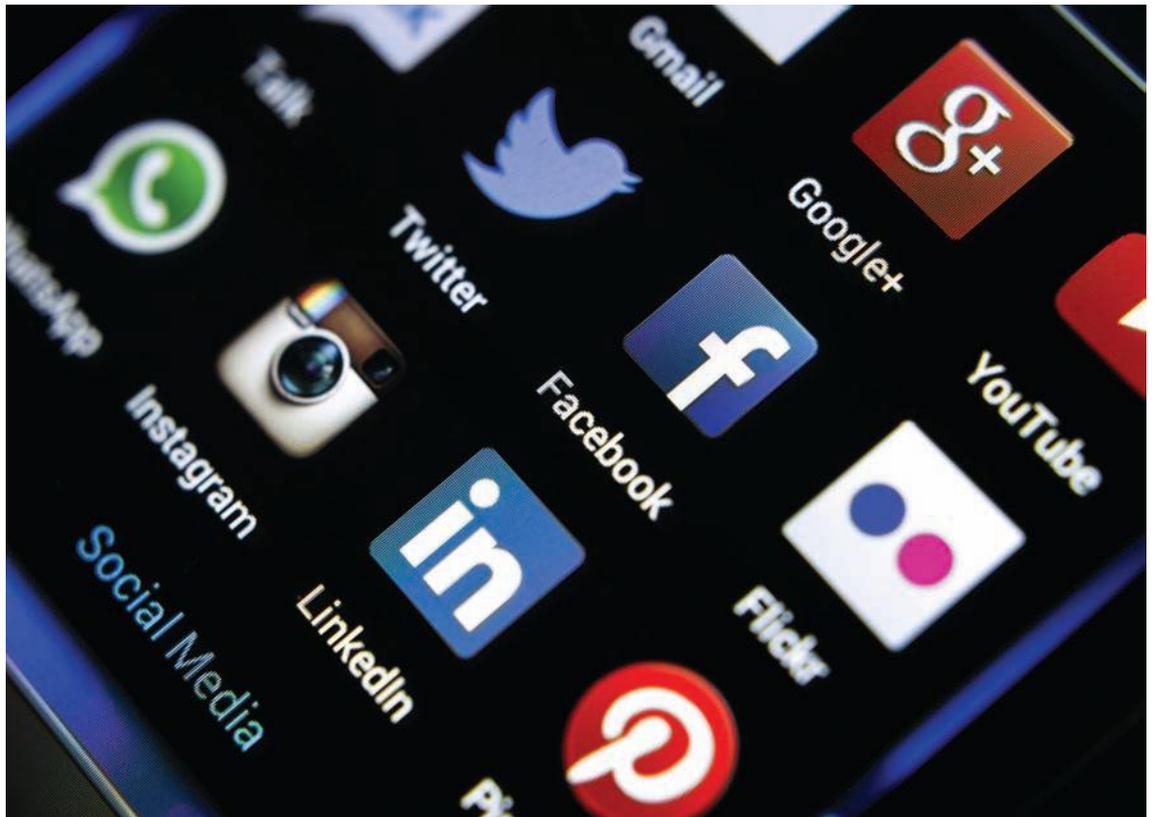


Figure 5.22 Media – integration, interaction and independence

now being overcome by collaborative software and social media applications.

Independence has also been made easier through technology. Now, instead of going to a course to learn something, we have access to learn online, in our own home and at our own pace. Something we may go to someone to fix,

we can now teach ourselves to fix. This improves our performance and allows us to develop skills we may not have learned. For example, media is leading to a transforming shift in business, technology and socio-cultural practices that is further driving the rapid expansion and uptake of design in the community.

## ACTIVITY 5.6

- 1 In a 400-word essay, discuss some ideas on what is achievable given the constraints of our current thinking and current resources and technology.
- 2 Explain in your own words what is meant by the three design principles that will assist in the prediction of design solutions – integration, interaction, independence – and describe how they will affect our lives.
- 3 Predict your own future direction for a design solution. Name the design solution and explain the future direction you propose.

## WaterWear backpack

Australia has quite a dry climate, and access to and availability of clean water are often topics of debate and consideration. Yet, for a majority of our population, it is only a matter of turning on a tap. In many developing countries, however, men, women and children are responsible for the collection of water, which may be some distance away. This job can be difficult and hazardous, as many carry the water on their heads and in containers that previously may have held poisonous material such as pesticides, paints and other chemicals that you wouldn't want mixed with your drinking water.

The WaterWear is a collapsible backpack designed to overcome these problems. It holds up to 20 litres of water. The collapsible backpack makes it easier to store and transport over uneven terrain. Constructed from lightweight and durable industrial-grade woven polypropylene, it features adjustable straps, a base that allows it to stand on its own while being filled, and a roll top that makes it

easy to remove the liner for cleaning. There is also a protected spout on the rear of the pack to keep the water clean for drinking and hand washing. Aside from the obvious benefits for those in developing countries, the WaterWear packs can also be distributed quickly in the event of disasters. Some 2000 WaterWear packs have been distributed in Haiti as part of on-site field-testing and there are plans for wider distribution in developing countries in the future.

- 1 Analyse the effect that this design solution would have on the lives of people in developing countries.
- 2 Analyse this design solution and the predicted future for this solution. Include packaging, agricultural, environmental and transport systems in your answer.
- 3 Critically analyse social, economic and ethical issues to do with this design solution for carrying water.



Figure 5.23 People carrying water containers in Africa

## Chapter summary

- Ethical design involves the study of moral dilemmas in designing.
- Designers have responsibilities to uphold when designing products, systems or environments. Three main responsibilities are ethics, honesty and environmental responsibility.
- Appropriate design involves the idea that consumers have needs and understand those needs better than anyone, and can therefore suggest or invent the technological innovations necessary to meet those needs.
- Innovation can be defined as the process of converting an idea or invention into a good or service that creates value for a customer. To be called an innovation, an idea must satisfy a specific need.
- New technologies that are currently developing or will be developed and that will substantially alter the business and social environment are known as emerging technologies.
- Individual, society and environment is a framework that suggests that an entity, be it an organisation or individual, has an obligation to act for the benefit of society at large. Every individual has an obligation to maintain a balance between the society and environment.
- Communities and individuals are making efforts to lessen the negative impacts of technology on the natural environment.
- Designing using appropriate technologies is having a fundamental impact on our society. There can be little doubt that it has made our society more efficient and raised the standard of living for most people.

- Design and technology is concerned with developing visions and strategies to assist nations, companies, communities and individuals to achieve sustainable prosperity, in an interconnected twenty-first century.
- Visions of future design refer to anticipating that which will or may come to be in the context of design and technology.

## Define key terminology

- 1 Appropriate technology
- 2 Design issues
- 3 Design solutions
- 4 Emerging technologies
- 5 Environment
- 6 Innovation
- 7 Principles
- 8 Responsible design
- 9 Society
- 10 Trends in design

## Chapter summary tasks

- 1 Research a fashion design company that designs clothing for tweens that adults could wear. Discuss potential ethical issues relating to this type of clothing.
- 2 Investigate responsible designers. Identify what qualities make a responsible designer.
- 3 Explain the four types of innovation.
- 4 Research James Dyson's innovations. Choose one and list the emerging technologies evident in this innovation.
- 5 Complete a table like the one below using information you have researched about the WaterWear backpack in Case study analysis 5.3.

	Individual	Society	Environment
Advantages	• •	• •	• •
Disadvantages	• •	• •	• •

- 6 List all the types of technology you have used since you woke this morning. How has technology impacted your life?
- 7 One of the design issues mentioned in this chapter is the use of technology that has saved time. Analyse what this means.
- 8 Refer to Vision 3 on wearable technology in Section 5.3. Discuss the impact on individuals and society this vision would have.
- 9 Find an innovation that has been developed in response to society (e.g. soundproof windows or 'green' cars). How were the needs of the community met by this innovation?
- 10 Refer to 'Spider silk for use in the military' in Section 5.1. Research and evaluate the major considerations that this innovation would need to have to be used in the military.

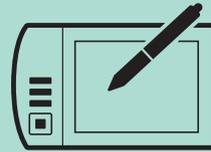
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## Extension tasks

- 1 Investigate CAD and computer-aided manufacturing (CAM) and critically evaluate the impact that these have had on society and the environment.
- 2 Create a 10-slide PowerPoint presentation that shows how designers and innovators can act ethically and responsibly.
- 3 View 'The Story of Stuff' on YouTube. Watch any one of the videos on water bottles, consumerism, plastic microbeads, capitalism or how things work. Create a summary of what you have learned from the video. Present your summary as a visual representation that you can hand to your teacher.

# 6

## Innovative, enterprising and creative design ideas and solutions



### Key terminology

**Brainstorming**  
**Collaboration**  
**Data**  
**Enterprising activity**  
**Entrepreneur**  
**Information**  
**Innovation**  
**Research**  
**Stakeholders**  
**Target market**

This chapter explores some of the creative tools that designers use in order to develop the most appropriate solution to their given design brief. This features research, as it plays an important role in informing the creativity in design work. When working as an individual or collaborating with other designers as a member of a design team, innovating through enterprising approaches can help produce the creative solutions that lead to success in design.

In order to develop a clear understanding of the content of this chapter, carefully examine the ‘Students learn about ...’ and the ‘Students learn to ...’ statements relating to **Outcome 5.4.1** in the New South Wales *Design and Technology Years 7–10 Syllabus*.

## 6.1 Generating creative and innovative ideas

There are many versions of the design process that designers use to create solutions to identified needs and problems. The specific process that a designer may choose to follow will often be the most practical or efficient for their situation. Regardless of the version that is used, the generation of initial ideas and refining them into a final solution always falls between analysing the given design brief and the production stage of the design process.

To ensure that the best possible solution has been developed for a client, the designer will analyse their given brief to identify what the final design requires. This may include the intended target market and what they like, the form it could take and what materials it could be made from. The designer must then determine the best way to gather this information using the researching tools at their disposal. Some of these tools and techniques are explored further in this chapter.

The process of innovation is based around the inclusion of emerging technologies into existing designs. Good designers and design teams will be knowledgeable about new technologies as they are developed and released into the market. During the process of developing solutions for identified problems, being able to include the latest technologies may give designers the edge over their competition, which can often translate into commercial success. Nowhere has this been more evident during recent times than in the development of mobile technologies, where miniaturisation has led to smaller and more powerful computing technology being used to create each new generation of smartphone and tablet.

With the brief analysis and research findings at their disposal, the designer is now best prepared to begin producing innovative solutions to meet the needs of their client or target market. As with research, designers will also choose the techniques best suited to them in order to harness their creativity. These techniques will help the designer move through the design process of creating a



Figure 6.1 Innovation in mobile technology as a result of miniaturisation is changing the way we use computers and the internet.

number of initial ideas, narrowing them down through ongoing evaluation and client or target market input until they arrive at a final idea and perhaps even create a prototype. Approval could then be sought for this proposed solution and it could be presented to the client or target market ready to begin production, or the designer could return to a previously eliminated idea should the result not be satisfactory.

### Creative and innovative idea-generation techniques

#### Research and investigation

Informed design is good design. In order to best meet the needs prescribed in a design brief, good designers will go to great lengths to ensure that they have all the background information they need to begin developing the best solutions. This helps ensure that nothing is left to chance, which is important in competitive design markets. Following the analysis of the design brief, the designer will have identified the key areas for research to inform their design work as well as the

**designed solution**  
 in Design and Technology, a product, service or environment that has been created for a specific purpose or intention as a result of design thinking, design processes and production processes  
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most appropriate and efficient methods of researching them. This gives the designer an action plan to work through to ensure they have the required understanding to begin creating the best designs.

Before the creation of initial ideas can begin, a thorough understanding of these particular areas is required:

- Existing ideas: Inspiration can be found in how previous people have attempted to produce solutions to similar problems, the materials used and the form the designs have taken. A plus, minus and interesting (PMI) chart is a cognitive organiser that can be used to help the designer identify the things they like and dislike in the existing designs and the interesting things that they would like to include in their own ideas. These inclusions can then be summarised in a mind map, for use when brainstorming and sketching the initial ideas in response to a design brief.

Existing idea	Plus	Minus	Interesting

Figure 6.2 A PMI chart

- The target market: For a design to be successful, it must not only address the needs identified in the design brief, but also appeal to the intended target market. Regardless of the size of the target market, if the design is not liked by those it is designed for, it is not likely to succeed. Understanding what is needed and desired by the target market, such as colour, size and materials, can help ensure that your design is popular and a commercial success.
- Materials, processes and production: Understanding the materials available can be essential when it comes to some designs. Different materials possess different attributes, including how much they weigh, how they can be manipulated and their cost. For example, aluminium is used in the

production of car bodies as it is strong and light. However, it is more expensive to purchase and requires specialised welding to join together. As a result, a car with an aluminium body may be lighter and more fuel-efficient but with a higher cost for manufacturing and sale.

### Brainstorming and mind maps

The first step in creating a **designed solution** once a design brief has been analysed and investigated is to generate initial ideas. Whether working individually or as part of a team, putting these preliminary ideas down is a process called brainstorming. Ideas are produced by the designer or design team after looking at their inspiration. Inspiration can come from the analysis of existing similar ideas, colour, shape or styles provided from the client or from the design brief itself.

When brainstorming, there is no such thing as a bad idea. In the long term, some ideas may prove to be impractical or too expensive, but all good designers will consider every idea in this stage. You never know when a fanciful idea may lead you to the best idea!

Brainstorming can happen using traditional design tools, such as a pencil and a sketchbook or butcher's paper, with the designer's ideas taking the shape of written notes, dot points or simple sketches. It is often informal; however, a cognitive organiser such as a mind map can be used to give some organisation to the process. A mind map can group like ideas into categories based on similar elements such as scale, materials or costs.

When the brainstorming process is exhausted and the designer has considered every idea they can, a process of review and analysis must be applied in order to determine which ideas best address the design brief. This ongoing evaluation will provide the best way forward through the next phase of the idea-generation process. An effective way to document the analysis against the design brief is to use a green pencil to mark the ideas with potential and a red pencil to mark the ideas that at this stage seem impractical.

### Concept sketches

Following on from brainstorming ideas for a solution to the given design brief, selected





Figure 6.3 A hand-drawn mind map is a useful tool for summarising the results of a brainstorming session.

ideas can move forward to the concept sketching stage. Ideas can be explored further through the process of concept sketching. Concept sketches will be used to discuss the potential ideas with others, including experts in the use of materials and techniques and the client themselves. Designers will begin to include features of form and function and their ideas will begin to take shape, becoming more than just a simple sketch or collection of words from a sketchbook.

As a result, concept sketches will need to include enough detail to allow people other than the designer to gain an understanding of the features and purpose of the design. This should include the use of colour and **annotations** of the features, including proposed materials, finishes and functions. Should any of these be left off the concept sketches, there may be some lingering doubt in the mind of anyone other than the designer who is required to interpret the ideas. This is poor communication practice for any designer and could lead to client dissatisfaction.

As with the initial ideas in the previous brainstorming phase, good concept sketches will include ongoing evaluation in the form of review and analysis provided by the designer

against the design brief. This will discuss the suitability of each design concept to meet the needs identified from the design brief and rank the concepts in order of suitability, for presentation to the client or target market.

**annotations**  
notes made on a drawing to describe particular points of interest

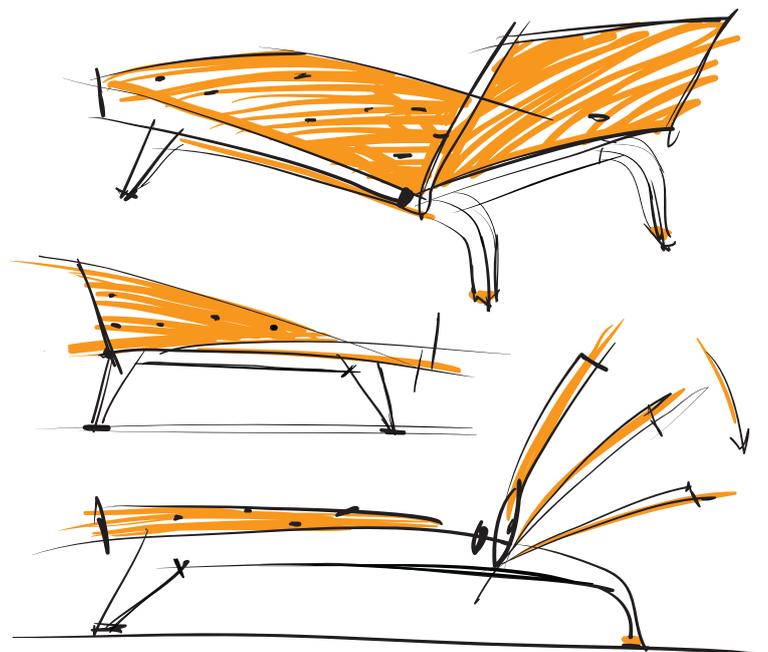


Figure 6.4 An initial sketch of an idea for outdoor furniture. Note the use of colour and folding backrest feature.

## Modelling

Following the evaluation of the concept sketches produced in response to the design brief, the designer, design team or client will decide upon the idea that will progress through to further development. Modelling is a very important tool for a designer and design teams to improve their understanding of the proposed design. Often designs on paper or screen are not enough for some people to get a true idea of the scale, function and form of a design, and a model can help with this.

Traditionally, some designers have used a range of craft techniques to produce physical models of designs to present to clients. These include automotive designers using clay to sculpt a full-size mock-up of a new car body for wind-tunnel testing, and architects using foam core board to build scale replicas of buildings



Figure 6.5 Cardboard is an inexpensive yet effective way to produce basic models of designs, as with this proposed office desk and storage.

to show their location on a block of land prior to construction. The industrial designers at Dyson use cardboard to mock up vacuum cleaner designs as a quick, low-cost way of showing how a new model can be packed away and stored.

In more recent times, designers are increasingly unleashing the power of computing to assist with the modelling of their designs with numerous benefits. Computer-aided design (CAD) has given designers a range of new ways to test the suitability of potential designs prior to approval for production. Automotive designers can now 3D-model their car body and wind tunnel-test a design virtually, saving time, space and money compared with clay modelling. Manufacturing robot designers can use CAD to model a robotic arm and animate it to demonstrate how it will work to a client, testing its full range of motions. A bridge designer can use a CAD model to simulate a material's strengths and survivability while accurately estimating its cost.

As discussed in the previous chapter, an emerging modelling technology that has been embraced by designers is 3D printing. This gives designers the ability to take a computer-generated design from the screen to a tangible object. It allows for the physical testing of designs for size and function as well as being a hands-on model with all the advantages of traditional modelling techniques. Unlike traditional methods, modifications can be made quickly to the CAD drawing and reprinted to test again, a process that is very time-consuming using handmade drawings and models.



Figure 6.6 CAD and 3D printing are revolutionising the prototyping phase of the design process.

## Observation

Observation is a tool often used by designers when seeking inspiration during the creative process. Designers will employ all senses in order to collect a range of data from the world around them. Primarily through the use of sight, designers will look to the world around them for inspiration or to gain a better understanding of the area or medium in which they will be working. Nature can provide much inspiration for designers. Whether it be the Australian bush to create a palette of colour for homes to blend into their surroundings, or the trend of **biomimicry** where designers look to nature to find sustainable solutions to human-made problems, observation is a valuable tool for sourcing inspiration.

When researching, observation can often be overlooked as a valuable tool due to its passive nature. Watching people in busy areas such as a shopping mall or festival event can give a designer insight and data for a wide range of variables, such as the paths chosen for movement of people through an area, the ages of the target market and their preference in clothing styles and colours. Designers can target specific areas to observe as identified in their design brief analysis and produce detailed results from the data. These data can be tabled

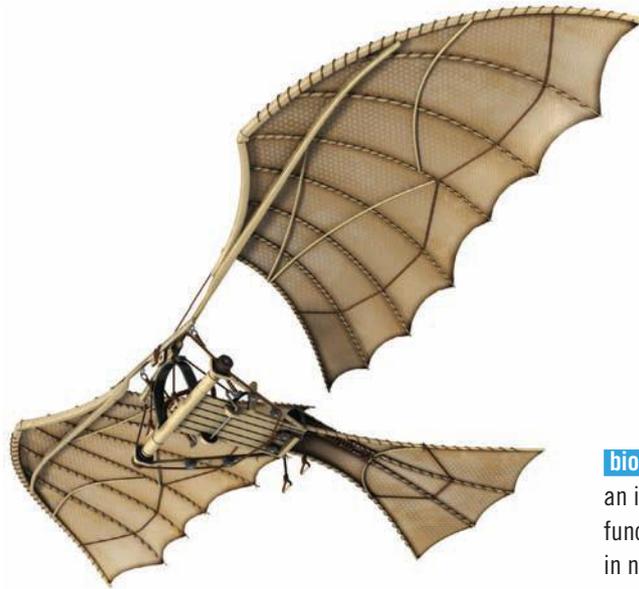


Figure 6.7 An early example of biomimicry, where Leonardo da Vinci used birds' wings as inspiration for a glider design

and graphed, making it easy to refer to when creating and refining initial ideas. Designers may also choose to make more general findings from their observations, writing detailed descriptions of what they have experienced during research that they can recount when the design work begins.

### biomimicry

an inspiration of functions found in nature for use and adaptation in the design of a product, service or environment or to solve human problems. For example, velcro fastening was inspired by small hooks on the end of burr needles. Termite mounds that maintain a constant temperature through air vents inspired architects to design cooling for buildings.

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Figure 6.8 Designers can learn a lot from making observations of their intended target market.

As valuable as observation may be to inspiration and research, it can also play an equally important role in further development of initial ideas when experimenting and testing. Once ideas have been modelled in order to test ideas and concepts, designers may choose to field-test ideas in order to observe their functional performance or aesthetic appeal. When developing a new community

garden, architects engaged by a local council may choose to produce a scale model of their proposed designs. Rather than actively survey or interview those who view the model, a researcher may step back and observe the reactions of those viewing it. This allows for raw reactions to the designs to be observed, rather than those made under the pressure of a face-to-face interview or survey.

## ACTIVITY 6.1

Education is evolving with new technology. However, traditional classrooms often do not keep up, and are still set up with tables in rows for taking notes from a board. The twenty-first-century classroom is a concept that features the latest in teaching technologies and tools at the centre of its design.

- 1 Conduct a PMI analysis of your current classroom to determine its suitability as a twenty-first-century classroom. Record your results in a PMI chart (see Figure 6.2).
- 2 Define the target market for a twenty-first-century classroom, and construct a survey to determine its needs for a modern learning space.
- 3 Brainstorm the requirements for a twenty-first-century classroom, identify its features and record your results in a mind map.

### collaboration

working together with others on a project for a common goal

### Collaboration

Not all designing is done in isolation by individual designers. Often they may work together in teams in a process called **collaboration**. There are a range of benefits to collaborating when generating ideas. When working by yourself, it is not uncommon to experience periods of ‘designer block’, where you have exhausted your ideas but may not be satisfied with what you have produced. When collaborating, you have other people to assist with brainstorming, each bringing a different design perspective, range of skills and understanding to the process. This may include specialists in areas such as materials, process and production, and the target market. Understandably, with this wide range of inputs into the creative process, a more comprehensive set of ideas can be produced in response to a design brief.

The introduction of computers and the internet to the work of designers has in turn had an impact upon how people collaborate. Traditionally, designers all had to be in the same room to be able to effectively

exchange ideas and develop design solutions. Telephones and email enabled designers separated by distance to be able to collaborate much faster than through post and fax, but time was still wasted waiting for a reply from team members. Now technologies such as videoconferencing and collaborative documents allow people with an internet connection to meet, share ideas and produce results regardless of their location.

Collaborating with others is by no means a guarantee of the best results. A lot of management work has to take place to ensure that team members work together smoothly. Like a committee meeting, one person should be delegated the role of team leader, to keep the group on task. Without a leader, the team may lose sight of the goals and not use time efficiently. The leader’s role is also important to manage personalities in a group; as with any group of people, some may not get along and it is important to ensure that the team can get the job done and not become distracted by personal issues between group members.



Figure 6.9 Collaboration can lead to a greater chance of success.

## 🔍 CASE STUDY ANALYSIS 6.1

### Himalaya Help – the Oxford Vaccine Group

Pneumonia is a leading cause of childhood death, affecting nearly a million children every year. An effective vaccination process of three shots over several months can protect children from this disease. These occur at six, 10 and 14 weeks of age. The UK-based Oxford Vaccine Group, from the University of Oxford, is conducting research into how pneumonia vaccines are used to determine if the vaccination can extend immunity in children through the critical first five years of life. Himalaya Help is based in Nepal, one of the poorest countries in the world and hence one of the countries with the greatest need to prevent child mortality. Here, researchers from the Oxford Vaccine Group are delaying the third pneumonia vaccination until eight months of age, with the hope that this delay will protect children for longer.

As with any research project, the collection, collation and storage of data are the greatest challenges. The time taken to record the data takes time away from actual research, meaning



Figure 6.10 Nepalese villagers collect water from a well for domestic use.

### cloud computing

distributing computing over a network where storage of files, processing of data and/or access to software occurs automatically on interconnected server computers to which the user's device is connected. Typically, people use the term to refer to accessing files and software over the internet. For example, photo files may be stored in the 'cloud' from a smartphone to be accessed later from a different location; where they are actually stored can be anywhere in the world on a server computer used by the cloudservice.

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that it can take longer to determine the results and, in this instance, potentially cost the lives of infants under five years old. Collaborating with the Oxford Vaccine Group is a team from the University of Oxford's Department of Computing Science. Its aim was to develop an internet-based **cloud computing** system that researchers could use to collate their data and maintain important details such as who entered the data and their location. Working in collaboration with Microsoft Research, the Oxford University team was able to adapt an existing software package used in cancer research trials to meet the needs of the Oxford Vaccine Group. Including features of a cloud-based spreadsheet, this software package is known as Vaccine Data Management (VDM).

Using cloud computing technology, Himalaya Help researchers can enter their data into their own internet-connected computers using VDM, which is then stored in the cloud server. This then allows researchers in Nepal to quickly and easily share their data with researchers at the University of Oxford in England. Both groups can work on the same

data to collate results and generate findings in real time, despite being on opposite sides of the world. Importantly, this system allows the Oxford Vaccine Group to manage the data securely and, in turn, protect the privacy of those involved in the trial program. Due to the time saved in data entry into one online location, more time can be spent by researchers on determining how long infants can be protected from pneumonia through the change in vaccination timing.

- 1 Using this example of online collaboration from the Oxford Vaccine Group in Himalaya Help, analyse the use of online collaboration to a team of designers.
- 2 Cloud-based spreadsheets, such as Microsoft Excel 365 and Google Sheets, are platforms that can be used for effective online collaboration. Using the internet, research other platforms and tools that can be used by design teams to collaborate when separated by distance and assess their usefulness.

## ACTIVITY 6.2

With the rise in popularity of mobile technology with consumers, a demand for their accessories has followed. This has included specialised accessories such as bicycle mounts for using GPS-enabled smartphones and shock-resistant tablet cases for tradespeople.

Collaborate with a partner to create a concept sketch for a tablet case for a schoolteacher. The case can include any features a teacher may find useful in their work. Outline the key features of your design in annotations of your sketch.

## 6.2 Research and exploration

Following the analysis of the design brief, the designers will have a good understanding of what will be required to create a solution for their client. But how can the designer ensure that what they produce is appropriate? Will it be affordable to produce, will the target market like it, and is it better than current designs? Designers can explore these and any unforeseen possibilities through research.

This will be examined in greater detail in *Design and Technology: Stage 6* but a brief explanation is that research can be divided into two categories:

- Primary research: This is hands-on research where the designer collates their own data using tools such as surveys, questionnaires, observations and interviews.
- Secondary research: Here the designer gathers their data from theoretical research from other people's research findings from sources such as books, journals and the internet.

When conducting primary research, the data collected can be quantitative or qualitative:

- Quantitative research is a scientific form of research. It may use a hypothesis for which the designer is attempting to prove or disprove a theory. Results are often numerical in form and can easily be analysed in tables or graphs. An example would be a survey used by a designer to determine a target market's favourite colour for a hat from five set choices. This form is most practical when researching large target markets.
- Qualitative research gives descriptive results, often based on the opinions and emotions of individuals. While results cannot easily be interpreted like data in a graph, these descriptive results can produce more detailed findings than quantitative research. An example would be an interview of students trying



Figure 6.11 A survey is an effective method of primary research that can quickly provide quantitative results ready for graphing.

to establish the style of clothing a new school uniform should feature. This method is most useful when designing for a client to determine their individual needs.

### Accessing information and data

Technology has had an impact on all aspects of our lives, and for designers looking to research it is no different. Notably the internet has revolutionised the way we research, due to the ease in which we can find the information we need quickly and effortlessly compared with visiting a library to search through books or journals. When accessing data, the internet is very useful for designers to conduct a preliminary search, with more traditional media used when a further in-depth search is required.

Internet research is a very quick and easy way to find information for design tasks, although it may not be as straightforward

### peer review

an evaluation of your work by others in the same field

as that. As researchers, we need to use our judgement when considering information from websites. Unlike a book or journal that undergoes a validation process, many websites are published without any fact checking. As a result, we need to determine how valid and reliable the information is that we are reading. Wikipedia is an interesting example of this, as anyone can manipulate the information on a Wikipedia page. It uses a process of **peer review** where other readers report inaccuracies in the information given, but this can take some time. When researching, don't take any website information as fact. Cross-check it against other websites to ensure that the information is valid. Use Australian websites (.au) where possible and look for reliable sources of information, such as government websites (.gov) and those of educational institutions (.edu).

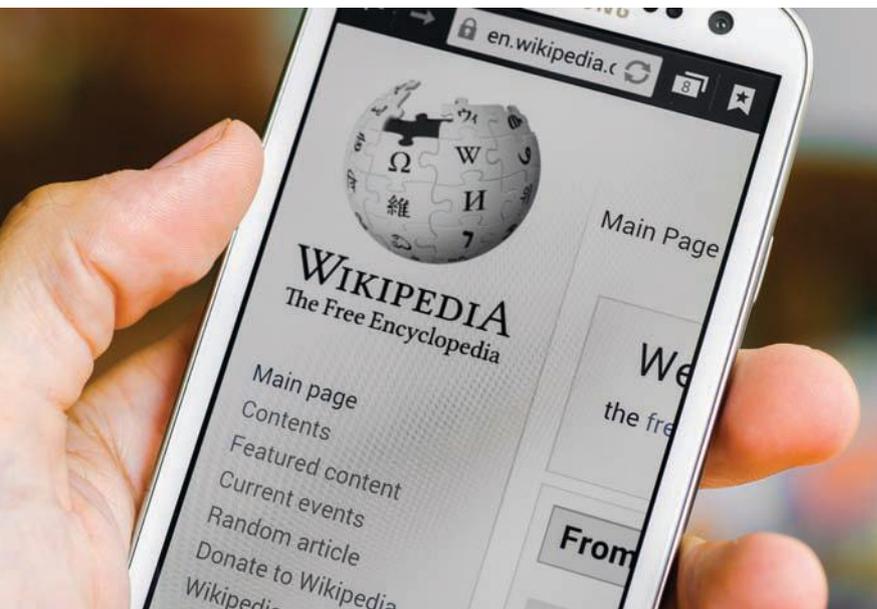


Figure 6.12 Wikipedia is a peer-reviewed website.

While print research may not be as convenient as using the internet from a mobile device, print media do have their benefits for researching for design. Journals, magazines and books all go through a rigorous process of review and validation prior to going to print. Once these media have been printed, it is very difficult and expensive to recall and reprint corrections, unlike information presented on the internet. Because of this, we can consider the information printed in journals, magazines and books to be reliable and can use it with

confidence. Journals are the main form of publication for the work of academics and researchers, and a good source of information for cutting-edge research findings. Magazines are very valuable for determining trends in popular colours and styles in design. Books generally contain a greater level of detail on their topics than other forms of publication, and are often better illustrated.

## Researching appropriate materials, processes and production methods

To ensure success in their final design, any designer must not only have a sound knowledge and understanding of the materials suggested for use, but also processes and techniques required for production with these materials. Should a designer not consider these factors during the idea-generation process, it may make their design expensive, excluding it from some segments of their proposed markets.

An example of this could be a child's bicycle. A designer's choice of aluminium may be a desirable material due to its high strength-to-weight ratio. However, its higher production cost and specialised welding needs when compared with steel may lead to a higher cost per bicycle. While some consumers will see the value in a lightweight frame and be prepared to pay more for a child's bicycle, many in the target market may prefer a less expensive option as their child will quickly grow out of a child-sized bicycle. Knowing about the higher material and production costs of aluminium as a result of research means the designer can make an appropriate choice of materials when developing their design for the specified target market.

Designers also need to be aware of external factors that may be imposed upon their work. This may include laws and legislation; for example, workplace health and safety legislation. Designers need to ensure that what they specify in a solution to a design brief will not cause any foreseeable harm to the user. Another factor that designers will need to consider is Australian Standards. These are regulations that are developed by government to ensure that what is being made and sold in Australia meets certain levels of quality. Australian Standards are available for a range

of items, including minimising pollution created by vehicle emissions and setting the level of safety for bicycle helmets. Prior to beginning the idea-generation process, designers need to ensure that any final designs they propose will at least meet, if not exceed, the minimal level set out in any relevant Australian Standards.



Figure 6.13 Australian Standards are set to ensure safety items sold in Australia, such as bicycle helmets, will protect us in case of an accident.

It is very difficult for a designer to be a specialist in the wide range of materials and the process and production methods that are at their disposal. While they may have an intimate knowledge of one or two materials from previous experience, designers can use research to develop their understanding of new materials and their requirements. Following initial internet and further print research of a proposed material, the designer can make contact with material experts in order to discuss the details of how they wish to use the material and estimate costs. This research can take place informally through phone conversations and teleconferences or through more formal means, such as minuted meetings or emailed quotations. Including such expert knowledge in their design work can help ensure the success of a designed solution.

## ACTIVITY 6.3

3D printing is a popular new technology being employed by designers when prototyping their latest work.

- 1 Using the internet, research the two most popular 3D printing plastics, ABS and PLA. Identify their names and describe their characteristics.
- 2 Using email or social media, contact a supplier of 3D printing materials to determine the cost of each of these plastics per kilogram.

### Identifying and summarising information from a range of sources

Successful designers are guided from brief to solution through the design process, a structure that leads them to the best possible outcome. When researching, it is important to apply a similar organised approach to ensure that no details are left out or forgotten, which can easily happen when dealing with large amounts of information. It is important to set up a system that suits the way we work as individuals, to ensure we can identify and summarise the information as efficiently as possible. This will include the type of data collected (quantitative or qualitative), the source (primary or secondary) and the method used to collect the data. The researcher must also consider the most appropriate method of research, taking into consideration people's rights to privacy.

When conducting quantitative research, researchers will need to identify what data they are hoping to gather. Regardless of whether a survey, interview or observation is being used to conduct the research, a table will likely be the most efficient method of summarising results from a predetermined set of variables; for example, popular car colours. A table can quickly allow raw data to be entered and can even give a tally summarising results without any other input. Using an electronic table in the form of a spreadsheet, data can quickly be turned into a graph. This is a visual summary of results that can be produced quickly and



Figure 6.14 Graphs are an effective method of summarising quantitative results.

interpreted easily, which can be referred to later when conducting design work.

As with quantitative research, when conducting qualitative research, the researcher must identify the data to be targeted. Qualitative research does not give pre-prepared variables for which one option is chosen; rather, the respondent can give their own interpretation for an answer. Due to the nature

of its descriptive and more detailed results, it can take longer to prepare, gather and interpret results; for example, favourite weekend pastimes. The researcher must take the time to read back through all of the results obtained and, from these, draw their own conclusions. These summaries can then be referenced once creative design work begins.

## ACTIVITY 6.4

When collating data, the use of a spreadsheet table is the most effective method of gathering results.

- 1 Using a spreadsheet, create a table that can collate the following data:
  - first name
  - shoe size
  - current shoe colour
  - preferred shoe colour.
- 2 Collect this data by surveying your class. As all good researchers do, ensure you have the respondent's permission to record the data. Once entered, experiment with manipulating the data:
  - a Sort the list of names from largest shoe size to smallest.
  - b Create a bar graph of the class shoe sizes.
  - c Generate a pie graph of the preferred shoe colours.
- 3 Identify the type of data generated in this task, and the category of research that has just been conducted.
- 4 Discuss which of the two types of data this research activity would be best suited to, and how you could better prepare to conduct this task.

## 6.3 Enterprising activity

As design work is often tasked with creating something new or reimagining existing things, it can often take significant effort to get the new design to market, despite how good the design is or even where there is an obvious need. This may be a result of the inclusion of new technology, a new style or even a new way of doing something, and with this can come the need for change. Change can be a challenging prospect for many people and as a result, to overcome resistance to change, the designer must not only possess skill in being a creative thinker, but must also be an enterprising one. This resistance to change can come from clients, retailers and, ultimately, the consumers themselves.

Enterprising activity is a term that is used in the business world to describe a project that is being undertaken that comes with some difficulty and requires boldness and energy to overcome. Designers see this difficulty as just another problem to solve, much like a problem presented in a design brief. Characteristics such as the ability to be innovative, to think creatively, to take risks and to have confidence in their ideas are all enterprising skills that a designer can apply to make their work a commercial success.

Scale can have an effect on the ability of designers to conduct their own enterprising activity. The smaller the venture, the easier and less expensive the costs will be to get the design to market. As the scale of project increases, so do the risks associated with it. Financial risk can be the main concern for many designers, as they are able to come up with great ideas but cannot afford to take the ideas to market. Some will even quit their jobs to focus on the development of their designs. This is where the **entrepreneur** plays a role in enterprising activity.

As a designer is an expert in using creativity to problem-solve, an entrepreneur is an expert in using initiative to manage risk in an enterprise. They may handle the financial risk through backing a designer's work with their own funds, or promote the work to those with

other sources of financing, such as government innovation grants and private investors. Entrepreneurs use their business knowledge and skills to take the burden of risk off the designer so that they may focus on the design development work needed to complete the project.

With increased investment in any project there comes more to lose for the designer and anyone invested in the project. Once again, the designer needs to move out of the design space and into the enterprise space to ensure that they protect their intellectual property from theft. There are several actions that the designer, or entrepreneur acting on their behalf, can take to protect designs:

- Patents can be applied for to give legal right of protection for a design, including how they work and are used.
- Registered designs protect the appearance of a design.

### **entrepreneur**

a person who sets up and manages new commercial enterprises to make a profit

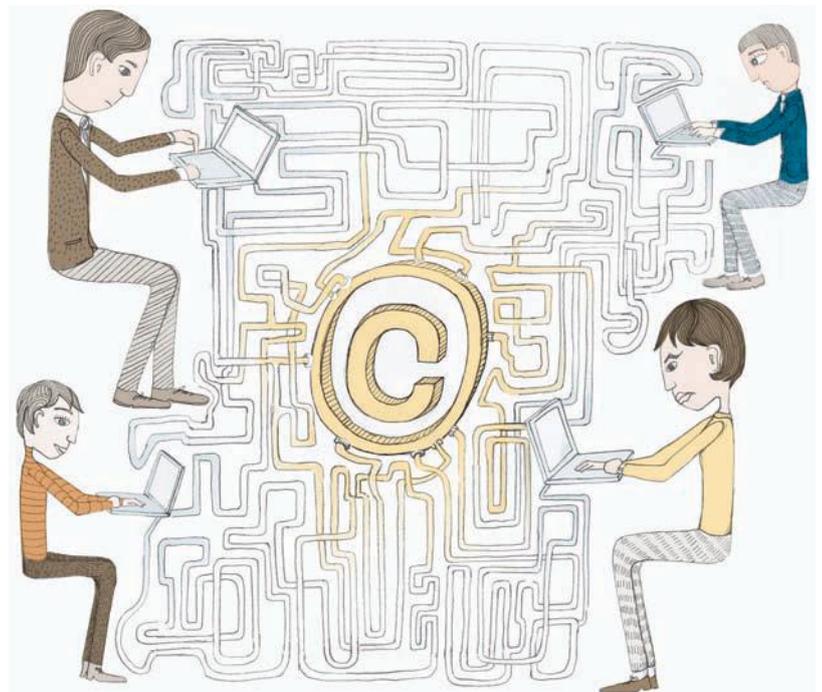


Figure 6.15 Depending on the type of work, there are formal ways of protecting the work of designers.

- Artistic works such as film, sound and computer games can be protected through copyrighting.
- Trademarks are used to protect branding of designs.

A level of legal protection can be given by simply being able to prove when the design work has taken place and by whom. A student design portfolio is evidence of this. It may be satisfactory when working on a smaller scale, especially as there is no additional cost to the designer. However, depending on the level of investment of time, effort and finances, many designers enjoy the peace of mind that formalised protection of their work gives.

## ACTIVITY 6.5

- 1 Define enterprising activity.
- 2 Describe the reasons why enterprising activity is important to the work of designers.
- 3 Contrast the work of an entrepreneur with that of a designer.

## CASE STUDY ANALYSIS 6.2

### Eco Splash System

Placid Pools is a swimming pool design and construction business based in Cairns, Queensland. While attending an overseas pool conference in Germany, CEO Joe Spelta discovered a new method of filtering pool water used in European pool systems. Based on the concept of biomimicry, the German systems emulated how nature filters water. Instead of using harsh chemicals, such as chlorine, as in traditional swimming pools, water passes through shallow filter beds containing plants and naturally occurring micro-organisms, simulating a small creek, to clean the water.

However, this biomimicry method of pool filtration had only been demonstrated in temperate climates. After seeing the environmental and energy efficiency benefits of the system, Joe Spelta saw a need for a similar system and was inspired to develop a version that could be used in the tropics of Queensland. As the project was different from the core business of Placid Pools, Joe needed to use his enterprising skills to make the concept a reality. He recruited team members to work on the project from across the industry who had an interest in the environment to collaborate with the existing staff at Placid Pools, including a diving professional.

The team not only collaborated among themselves, but also with the German company

responsible for developing the temperate filtration system. This partnership enabled the Placid Pools team to share the existing technology as a basis to develop and perfect their tropical biological water filtration system, the Eco Splash System (ESS). Using inspiration from the constant water flow in nature, the team was able to do away with the use of chemicals and reduce ongoing running costs of a conventional system by a third. It can even be retrofitted to existing pools.

There were challenges along the way in developing the ESS. As a family-run business, it was difficult for Placid Pools to attract government tax concessions for its research and development work. It also had trouble gaining appropriate direction and advice over protecting the intellectual property it had developed. Fortunately, this self-funded venture won the Tropical Innovation Award, giving the team an added \$10 000 towards the project's development. Current environmental legislation in Australia states that pools must be chlorinated, and this challenge requires further enterprising practice from Placid Pools. Currently the company is undertaking research, educating legislators and working closely with the Swimming Pool Association of Australia in an effort to overcome this barrier to its innovation.



Figure 6.16 An Eco Splash System pool water filter

The next enterprising challenge for Placid Pools was to bring the ESS to market. With Placid Pools already in the pool construction and retail business, General Manager Amanda Spelta identified an opportunity to move further into the retail market to sell the company's new product. This allowed it to take advantage of the needs of its current customers for a chemical-free alternative to existing pools. Further innovation was made by Placid Pools

in the way that it demonstrated its products to customers, through the development of a multi-pool display centre, allowing future customers to experience the pools and the ESS as they could be installed in their own yards.

Assess the value to Placid Pools of an entrepreneur assisting the family-run business with the development of the Eco Splash System.



Figure 6.17 Market selling unlicensed 'knock-off' goods, Thailand

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## Chapter summary

- Creative design solutions are most effective when the process is informed by appropriate research and investigation of the target market, materials, processes and production methods.
- When working in isolation or in a design team, brainstorming is the first step in creating ideas and is best recorded in a mind map.
- Concept sketches are used by designers to give form and aesthetics to initial design ideas.
- Computer-aided design (CAD) and technologies such as computer-aided manufacturing (CAM) and 3D printing are used by designers for prototyping and modelling.
- Observations are a non-invasive way to investigate target markets, proposed designs and the way they interact with the world around them.
- Through collaboration, designers work together to widen the range of skills, knowledge and experiences when responding to produce better solutions to design briefs.
- Research can come from primary or secondary sources.
- Data produced from research can be quantitative or qualitative.
- Enterprising activity is required to take a design from concept to market.
- Entrepreneurs are risk-takers with business and marketing skills who conduct enterprising activity on behalf of designers.

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## Define key terminology

- 1 Brainstorming
- 2 Collaboration
- 3 Data
- 4 Enterprising activity
- 5 Entrepreneur
- 6 Information
- 7 Innovation

- 8 Research
- 9 Stakeholders
- 10 Target market

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## Chapter summary tasks

- 1 List the different forms of research that designers may use to inform their work.
- 2 Describe the results of a brainstorming activity you have recently undertaken when working on a design brief.
- 3 Discuss the advantages of collaborating when designing.
- 4 Describe an enterprising activity that a designer may undertake when promoting their work.
- 5 Entrepreneurs may have a different skill set to designers. Identify the skills unique to entrepreneurs.
- 6 Describe the advantages of using CAD when developing ideas into a final solution.
- 7 Identify different types of data that may be produced during research. Give some reasons why specific data choices are necessary.
- 8 Compare the differences between primary and secondary sources of information.
- 9 Identify an innovation and justify why you have classified it as innovative.
- 10 What is a target market? Describe the importance of addressing the needs and wants of a target market to the success of design work.

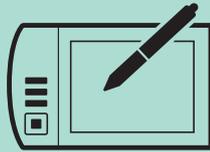
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## Extension tasks

- 1 Identify a design from an industry you are interested in. Propose the research methods that the designers could have applied before creating their initial ideas and justify the selection of each.
- 2 Construct a process of creative techniques that may have been used to develop your selected design. Describe how each technique could be used in your own design work.

# 7

## Appropriate techniques



### Key terminology

**Communication**  
**Computer-aided design (CAD)**  
**Design portfolio**  
**Documentation**  
**Information and communications technologies (ICT)**  
**Marketing**  
**Prototype**  
**Sketches**  
**Stakeholder**  
**Target audience**

This chapter explores methods that designers can use to communicate their design process and solutions to different target audiences, including other designers and clients. A range of communication methods are available that can convey different information in different ways, and their use is determined by the needs of the target audience. Whether a design portfolio or multimedia presentation is being used, the designer will develop a marketing strategy incorporating these communication and presentation techniques to ensure their work is fully understood.

In order to develop a clear understanding of the content of this chapter, carefully examine the ‘Students learn about ...’ and the ‘Students learn to ...’ statements relating to **Outcome 5.5.1** in the New South Wales *Design and Technology Years 7–10 Syllabus*.

## 7.1 Communication and presentation techniques

The ability to convey ideas to clients, manufacturers and target markets is core to the success of any designer. Poor communication can lead to a client selecting a competitor over yourself for a project, or a manufacturer producing a product not to your correct specifications. Both of these scenarios can lead to wasted time and lost income for a designer. Good communication is as important as good design, with the appropriate selection and use of communication and presentation techniques playing an essential role in getting your message across to key **stakeholders**. For designers, communicating occurs across a range of media, including documentation and presentation.

### stakeholder

a person or group with an invested interest in the outcome of a design process

### design portfolio

a document used to record the design process used when producing a solution to a design brief

The documentation of work completed during a development process is important for all designers, and this commonly takes place in a design portfolio. A **design portfolio**, or 'folio', recounts the steps taken as a designer produces a solution to a design brief. This

moves from identifying and analysing the need through to the final evaluation, and is used for personal use or communicating with other designers. It allows a designer to return to any stage of their design process, review what took place and make any changes or modifications quickly and easily as a result of final or ongoing evaluations. When collaborating with other designers as part of a team, it can enable each person to know what the other designers have been working on, ensuring that stages are not duplicated or even left out completely.

Presentations are required when design ideas need to be communicated to clients, manufacturers and target markets. As these groups may not be familiar with the forms of communication techniques that designers use, it is important to make sure that appropriate methods are used. This may include using different language that is not as technical, more labelling of diagrams to ensure understanding and more illustrations than text. While a



Figure 7.1 Presentations are an effective method of communicating ideas to a client.

folio is a very useful medium for presenting design ideas to stakeholders, designers may also need to consider more engaging ways to present their designed solutions. This may include multimedia options such as projected slide shows, computer animations and 3D simulations. Even physical prototypes can be a valuable resource. Considering the negative impact that miscommunication can have on the success of design work, the importance of effective communication is critical.

Designers have a range of tools at their disposal, each able to deliver specific information to a target audience in their own way. These can be used in portfolios or presentations, and designers must be selective in their choice as well as their application of the following communication and presentation techniques.

## Visual and graphical

A popular saying is that ‘a picture paints a thousand words’ and this could not be truer in the world of design. The ability to explain thoughts and ideas quickly and easily to people is the main reason why designers see so much value in visual and graphical communication techniques. Regardless of your target audience, large passages of text can be off-putting, no matter what measures have been made to make it easier to read.

- Sketching is a most simple form of communication. **Concept sketches** are hand-drawn quickly using graphite (lead) pencils during brainstorming sessions to record initial design ideas. Whether in two or three dimensions, they are very effective when working with others to ensure understanding of function and aesthetic. These can evolve into renderings through the addition of colour and shading. This helps the designer to develop the aesthetics further as the final design idea begins to take shape.
- Orthogonal projections are technical-style drawings that are to scale and allow the designer to share important information such as dimensional and material information. When drawn in third-angle projection, orthogonal drawings illustrate a front view of a

project, aligned to top, right and/or left side views. Often referred to as ‘plans’ or ‘workshop drawings’, they are used for final design drawings of products, ready to be passed onto manufacturers to produce a prototype or production model of a designed product. Orthogonal projections can be hand-drawn or computer-generated.

- Isometric projections are three-dimensional illustrations drawn to scale and are complementary to orthogonal drawings, giving an angular view of the product that includes the front, top and right or left side views. Unlike an orthogonal drawing, an isometric view gives a more complete idea of the design, sacrificing some of the technical information being presented in the process. As a result, orthogonal and isometric drawings are often presented together so that the designer can give the intended audience as much information as possible. Isometric drawings are produced by hand, with most computer-aided design (CAD) drawing packages able to easily produce an isometric view.

**concept sketches**  
the first ideas produced when using a design process to develop a solution to a design brief

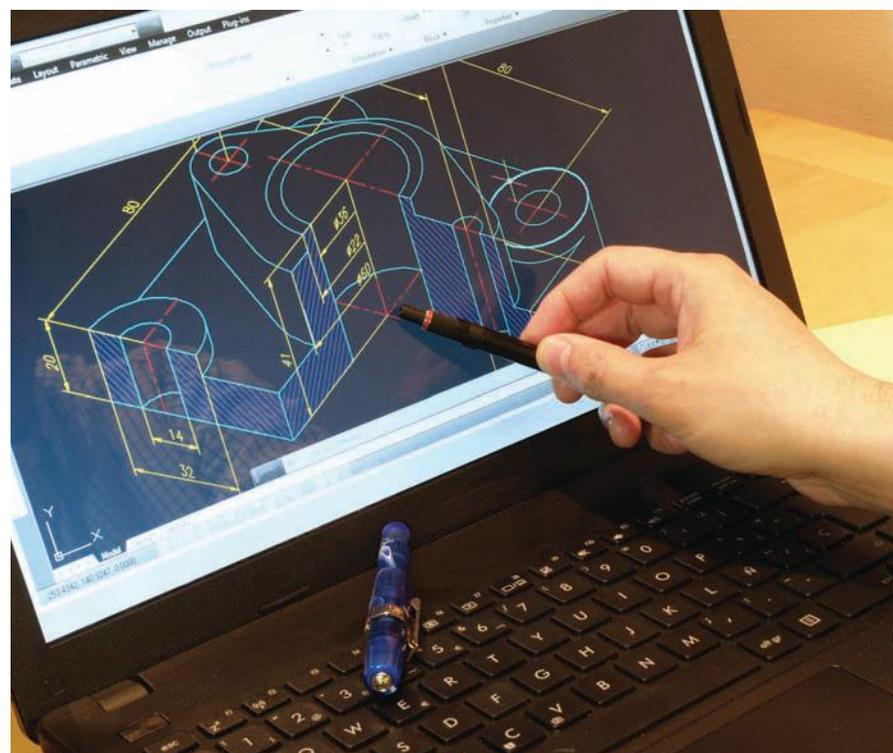


Figure 7.2 A CAD version of a component in isometric view, showing some technical information

Other forms of graphical presentation include the following:

- Oblique projection is a simpler form of three-dimensional drawing than isometric, where an orthogonal front view is given with a side and top view projected at 45 degrees. It is used to produce quick three-dimensional views where scale is not as important.
- Perspective projection is a three-dimensional drawing where each horizontal line is projected back to a vanishing point on a horizon. This form of drawing is useful for giving an impression of a design in use, such as a house sitting on a street, where technical information is not important.

It is not always a design that is being communicated through visual and graphical means; other information of importance can also benefit from a wordless approach. This is very valuable for designers where their work needs to be interpreted by users speaking different languages or with low levels of literacy. Some of these include the following:

- Logos are used to communicate a company or product branding easily. Most successful logos are recognisable without the use of any text at all.
- Symbols can be used like a logo to communicate general information. The red no-smoking sign is a great example of an easily recognisable symbol. Keys on a map are another example of an application of graphic symbols.
- Charts and graphs are used to present results from research quickly and easily for those needing to interpret them. **Gantt charts** are a visual way of presenting action and time plans when managing a project.

Sometimes a designer will need to illustrate the form of a design, and being shown on a page or a screen does not do it justice. Simple models made from cardboard or clay through to complex 3D-printed prototypes are valuable, as they are tactile as well as visual. They can be picked up, handled and tested for size, shape and function.

## Written

Despite the value of visual communication forms to designers, there is still an important role for written communication.

Design portfolios are an important medium for project management, used by all good designers around the world to document their progress through the design process. Primarily used to communicate design work to other designers, the design portfolio is an important record of the work done while producing a solution to a design brief. Vital information documented in a design portfolio includes:

- the design brief – the goal for the design work and the wishes of the client
- action and time planning – the steps that need to be taken to complete the design work and the time required to do so
- research results – the findings of investigation that will inform the idea-generation and refinement process
- ideas development – while sketching is a visual medium, annotations explaining the features of the ideas and ongoing evaluations of this work will be in written form
- evaluations – periodic review of the progress and a final summary of the level of success towards meeting the design brief.

Instructions may need to be given for how a new design is to be used. Illustrations may be able to provide good step-by-step instructions, but further details or advice may need to be included to ensure that nothing goes wrong for the user. Descriptions can be written to give a greater level of detail when a more formal format is required for the target audience. This can be seen in instructions supplied with products manufactured for sale in world markets, with the written information reproduced in different languages, to reinforce any illustrated steps and to ensure that the correct message has been communicated.

Specifications for designs, whether from a client or given to a manufacturer from a designer, are another example of written communication. While they may be supported with a diagram, these are documented in text so that there is a concrete understanding

### Gantt chart

a detailed grid that displays the tasks to be undertaken and time allocated, and maps these on a specified timeline

between parties to ensure what is delivered is what was requested. Materials and cutting lists are given in written form for this reason.

Written communication is important not just for design work, but also for entrepreneurial work. Designers working on a small scale developing their own ideas may not have the capital to bring their work to market. They may apply for funding from government agencies or private funding sources, and the ability to share their ideas and vision succinctly with detail will require effective writing skills.

## Oral

Spoken forms of communication are essential when designing. The ability to hold a conversation is a crucial social skill required by designers. Oral communication may be used to:

- discuss the parameters of a design brief with a client
- conduct a survey with a focus group or interview an individual from a target market
- speak with a supplier of a proposed material
- brainstorm ideas collaboratively with a design team.

The ability to select and use the correct oral communication techniques appropriately is an advantage for those wishing to be successful designers. Knowing what questions to ask is just as important as being able to ask them. The right questions will produce the desired answers; not asking the right questions may mean that you do not have the information you need to proceed with a thorough designed solution.

Where oral communication comes into its own is when making presentations. It is the spoken word of the designer that makes links between the visual, written and digital forms of communication. These are all effective methods of sharing ideas and information with a target audience; however, it is the ability of a designer to give different interpretations of the same information when presenting that ensures that true understanding occurs. Designers can use their skill in oration to engage a target audience and persuade them



Figure 7.3 Discussing the design brief with a client is an important form of oral communication.

that their proposed design is the best for them, using a tone of voice that is reassuring during a time of decision making. These are important skills when the success of a design career or business depends on it. This is why special presentation events are able to help launch new products to market, especially in the technology sector in recent times. Steve Jobs was well known for his talent for public speaking when unveiling new products during Apple presentations.

## Digital

Recent times have seen great advances in the ways we can communicate using digital technologies. With computers, the internet, mobile devices and **social media**, designers now have a more comprehensive set of tools to communicate and present their work than just visual, written and oral techniques.

Design portfolio work has become easier for designers. Written work can now be drafted electronically on a computer or mobile device, typed or converted to text using voice-recognition software. Changes can be made

**social media** websites and applications that allow users to create and share content through social networks



Figure 7.4 Social media platforms such as Facebook are an effective way to promote the work of designers.

easily, spelling and grammar errors quickly identified and documents stored in the cloud to access anywhere the internet is available. This allows for flexible, efficient and more professional looking written work. Multimedia content can also be included in preference to still photography.

Digital content, such as photos, video and CAD, gives great flexibility to designers. Videos and animations can, in a short amount of time, communicate what may take several pages of written instructions and step-by-step illustrations. Once created, they can quickly and easily be added to portfolios, presentations and websites. They can be updated and changed quickly without having to start from scratch, freeing up time for designers to spend on designing.

Social media has revolutionised the way in which we produce and share content. Unlike email, which is a one-to-one form of communication, social media is one-to-many. It is a quick and easy way to promote design work, seek feedback from a target audience and launch a new product or service. Social media allows users to 'share' the item of information you wish to communicate, as though it is being communicated by them, giving a whole new dimension to the way in which target audiences receive information. Facebook and Twitter are two of the most popular forms of social media.

## ACTIVITY 7.1

- 1 Outline the following communication techniques and identify a possible target audience for each.
  - a design portfolio
  - b multimedia presentation
  - c concept sketch
  - d orthogonal drawing
  - e isometric drawing
  - f CAD
- 2 CAD is a powerful digital communication tool that designers can use to model their ideas and share their design's technical information with others, including manufacturers. Using the internet, research three different forms of CAD and compare them using a plus, minus and interesting (PMI) chart. Make sure you include at least one software package used for 3D modelling and one used for architectural design.

## 7.2 Selecting an appropriate technique

Do you know who your target audience is? Before any communication techniques can be selected to communicate your design, you must have a sound understanding of your target audience. This includes having an understanding of variables such as their age, cultural background and technical understanding. Knowing things such as how much detail and information they want, along with the best way to communicate with them, can only be determined by investigating the target audience.

This can include:

- interviews – interacting with individual members of the target market for a detailed response regarding their background
- surveys – seeking a more general response from a large number of target market members
- observation – stepping back and not interacting directly with members; rather, watching and noting who makes up their target market

- researching – reviewing existing records, such as census data and other forms of public information.

Once the target audience is understood, it is the content that needs to be considered. What information needs to be conveyed to them? When collaborating with other designers, selecting the right communication techniques is somewhat easier, as assumptions can be made that they have the ability to comprehend a similar level of detail to yourself. What is produced and documented during the design process in your design portfolio, including annotated concept sketches and technical drawings, will be satisfactory.

However, presenting to other audiences can be a different prospect. Too much information may overwhelm them and not enough information may leave them not understanding the message you are trying to convey.



Figure 7.5 Workshop drawings communicate specific details for designed ideas to those who will manufacture them.

## Appropriate to various audiences

When selecting the most appropriate communication techniques for your target audience, there will be strategies that can be utilised to ensure that the information you are presenting is understood. When communicating with those who do not speak English as their first language or those with poor literacy skills, it is important to limit the use of technical language and large chunks of text. Breaking down the information into smaller passages of text and including diagrams, illustrations and animations can make the information more accessible. As with instructions supplied with products for global markets, designers may need to consider presenting their ideas to potential audiences in alternative languages.

Information prepared for those with a technical background who work with designers, such as product manufacturers, will need to be detailed and specialised. Examples include a materials list that specifies size, types of materials and tolerances for parts required in order to supply the next phase in production,

and workshop drawings that show how the parts are to be assembled by those working on the factory floor. When communicating your ideas to audiences such as these, the more technical detail provided can ensure that your design is realised as it should be, without costly errors along the way.

Working on a commissioned design for a client, it is essential to ensure that appropriate communication techniques are selected. If they do not feel that what is being produced is what they had pictured, they may take their business elsewhere. Sharing the evolution of ideas from brief through to final concept is best done using annotated sketches, finishing with a 3D rendered illustration and possibly a prototype. An action and time plan in the form of a Gantt chart will map out how long the client will have to wait until the design is ready for them. A finance plan will indicate to the client how much the design development has cost them and predict the final cost of the production of the design. Being able to communicate vital information to this audience can be critical to your success as a designer.

## ACTIVITY 7.2

When documenting work throughout a design process, designers need to be skilful in the use of a range of communication techniques, including traditional methods and ICT-based methods.

Under the direction of your teacher, produce a design portfolio for publication for your current design project. Products, systems and environments all require different methods of communication to best convey their function and aesthetics, and your teacher will direct you in the most appropriate ones to choose. Aim to include:

- word processing of written information to document your design brief, research findings and your evaluation
- a Gantt chart as a visual way to display your planning of your actions and time usage
- graphical communication of your ideas development using pencil sketching of initial ideas and colour rendering possible solutions, leading to a computer-generated drawing of your final solution.

Once completed, prepare your documentation for publishing. This may take the form of a physical portfolio, printed and presented in a display folder. Alternatively, it may be an electronic version in PDF format, with a compressed file size for easy sharing on the web, or a high-quality interactive presentation with video capture of the final design being tested. Check with your teacher for their preferred method of publication.

## Communicating the Dyson design process

Dyson, the company best known for its development of industry-leading vacuum cleaners, began in 1978 when James Dyson became frustrated with his own vacuum cleaner and its loss of performance during use. Inspired by his earlier creation of a cyclone tower to separate paint particles from air, he decided to apply this technology to household vacuum cleaners. Five years and 5127 prototypes later, his design developed to become the best available on the market. His ability to develop these ideas and communicate them effectively to others has played a vital role in the growth and success of his business.

When Dyson identified the problem that previous designs of bathroom hand dryers left your hands still damp and able to spread bacteria and viruses, his organisation applied its design process and knowledge from vacuum cleaner development to produce a solution, the Airblade. As it moved through this process, it communicated its work using a range of appropriate communication techniques (see Figure 7.6).

Initially, pencil hand sketching and colour renderings are used to record the ideas created during the brainstorming process. At this stage there is not a fully formed idea for aesthetics or function. Sketching is used as it is a quicker and more descriptive communication technique during this stage. These early ideas are based on research of existing hand dryers and the knowledge of their company's air filtration and air suction technology. Designers working in collaboration can evaluate each other's work against the requirements of the design brief and work towards a possible solution, using annotations to record finer details of each design.

Modelling is a large part of product development at Dyson, as it allows the designers to share the physical details of their ideas in the form of a tangible object. Cardboard models are used as a quick and inexpensive way to communicate the size and shape of ideas with

others working on the new project, along with testing these elements of the designs.

With a suitable design settled upon, it is then refined using CAD drawings. These communicate the technical information of the designed solution to the manufacturing division of the Dyson company. The modelling process continues with 3D modelling used to virtually test the function of the design, and the specified materials to be used. A 3D-printed model is then created using a process called selective laser sintering (SLS), a high-quality 3D printing process. These prototypes can then be tested, refined and proven before the CAD drawings are finalised and used to manufacture the final Airblade product.

A proven product design process, based on the appropriate use of communication techniques, has been applied again and again by Dyson and his team of designers. Since the success of the Airblade, they have gone on to refine this product further and to incorporate their hand drying innovations into a wash basin tap, the Airblade Tap, which saves the need for separate tapware and hand dryer and gives more space in the bathroom.

- 1 Using this example of the use of communication techniques, evaluate the use of sketching and modelling by Dyson in the development of its product design ideas.
- 2 Sketching and modelling are just two examples of methods that designers can use to communicate their design ideas to others. Propose another technique that the team at Dyson could use and justify your selection.

# the design process

Designing the Dyson Airblade™ hand dryer

"Design and technology is about thinking big. It's about creating and making your ideas become a reality. And while it doesn't always go to plan, it's about learning from your mistakes."  
*James Dyson*



**How it works**

Air is sucked into the Dyson Airblade™ through a filter to remove 99.9% of bacteria.

The air rushes at 400mph through a slot the width of an eyelash to wipe water from hands.

The waste water is disinfected by an iodine resin filter and released as a harmless invisible mist.

The Airblade™ hand dryer uses Dyson's Digital Motor to make it energy efficient.

www.jamesdysonfoundation.com

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Figure 7.6 The design process of the Dyson Airblade hand dryer

## 7.3 Marketing strategies

To ensure the success of their design ideas, a designer must not only be a creative thinker but also think like an entrepreneur. A design is only truly successful if it is being taken up by customers in its intended market, and unless they are aware of its existence it is difficult for this to occur. That is where marketing comes in. Marketing is the process of using research and advertising to promote products and services. This can be undertaken by the designer or by an entrepreneur on the designer's behalf.

A popular tool for determining a marketing strategy is known as the '4 Ps' of marketing. This has now been extended to the 7 Ps to include, People, Processes and Physical Evidence. However, we will focus on the 4 Ps in this discussion. Also known as the 'marketing mix', the following four variables are blended together to ensure that the desired result is achieved when connecting with the desired target market:

- **Product:** When marketing a design, the designer must consider its quality, features, packaging and any customer support that will be provided. Does it look like something that a potential consumer would like to own?
- **Place:** Can the design easily be transported and distributed? Consideration needs to be made regarding where it can be accessed by the potential consumers.
- **Price:** How much will the design need to sell for to cover costs of manufacturing and advertising? When profit is being calculated, will it be affordable in the marketplace or be out of reach for the target market?
- **Promotion:** Communicating the benefits of the design to the target market, using the marketing strategies best suited to the audience.

There are a range of promotional strategies that can be used to make a target market aware of a new design:



Figure 7.7 Traditional print media and their more recent online forms are popular for marketing the work of designers.

- Print advertising is a very traditional form of marketing that became popular with the beginning of black-and-white newspapers, followed by colour magazines. Used to access broad audiences, it uses pictures and text to promote a design. Junk mail comes into this category, as do billboards. Its reach is limited to the circulation of the printed document.
- Radio advertising is a non-visual medium that relies on sounds and voices to describe a design and its function and aesthetics. It is popular for reaching broad audiences, including target markets that have a radio playing all day, such as tradespeople on building sites. Its reach is limited to the broadcast region, unless the radio station also broadcasts online.
- Television advertising marks a leap forward from radio advertising. Television allows broad audiences not only to see what a design looks like, but also to watch how it works. As with radio, its reach is also limited to the television station's broadcast region.
- Direct marketing targets individuals. Organisations will send personal emails or mail pamphlets directly to people taken from a list identified as being in the sought-after target market. This information can be gathered from a range of sources, including website registrations and competition entries, and is useful when promoting specialised designs.
- Telemarketing is a more intrusive version of direct marketing, using telephone calls to directly contact people identified from the sought-after target market. This can be quite unpopular with those being called.
- Online advertising is a recent marketing medium that allows for the use of many of the features of other marketing media. Print advertising can be used on websites, sound from radio can play and videos from television can pop up, making it a very flexible medium for marketers. This form of advertising can be placed on websites that members of the desired target market would visit. Websites often use software that remembers the topics you have viewed online and customises your advertising to suit your demographic and interests. Linked to the website design, advertisers earn an income every time an online advertisement is clicked. Advertisers can also pay to have a website appear as a popular search term when a related query is made on a search engine.
- Social media are being used to market designs in ways that are still being explored by creative advertisers. Videos promoting the work of designers can now become viral – online content is created and planted within a social media platform and shared uncontrollably by members of the target market. Unlike many other forms of advertising, once the content is created, there are no other costs for the advertiser, making it very popular with small organisations.

### **ACTIVITY 7.3**

Subject selection time can be a busy time for school staff and students alike. Year 10 students are required to choose the elective subjects they wish to study for the following two years, including in the Higher School Certificate, prior to joining the workforce or going on to further study.

In groups of four, present a marketing strategy that could be used by your school to promote the Design and Technology course to potential students in the senior years. Remember to consider your target audience and forms of media that they will engage with. Present your strategy to your peers and your teacher using a presentation software package such as Microsoft PowerPoint or Google Slides.

### Using information and communications technologies to produce a solution: the NSW Mental Health Line



Figure 7.8 The NSW Mental Health Line logo

As demand increased for access to mental health support services in New South Wales, the state government launched the 1800 011 551 NSW Mental Health Line in 2012. This service provides universal access to mental health telephone triage, referral and advice, including appropriate service options, which is accessible to the people of New South Wales 24 hours a day, seven days a week. The service allows those seeking to speak with a mental health professional access to them outside usual business hours, a service especially beneficial for those in rural and remote areas.

Managed by the NSW Ministry of Health, information and communications technologies (ICT) enabled one phone number to be used to connect people to local professionals

through the use of geo-location software.

This technology is able to determine the geographical origin of the caller and redirect their call to the most appropriate location, based on the option selected by the caller. For this to occur prior to geo-location software technology, direct numbers would need to be listed for the individual Local Health District Mental Health Services. The caller would have to make a decision regarding which service they needed. The new centralised service provides a telephone triage facility, directing callers to the most appropriate service.

Voice-recognition software is another ICT built into the NSW Mental Health Line. Should the client wish to connect with a particular service or different geographical location, a



Figure 7.9 Geo-location software connects callers to their local service provider while only requiring one phone number for all of New South Wales.

voice-controlled menu system allows for easy navigation through the menu options.

As with most new technology, there was a transition of the workforce to the new systems required to make the NSW Mental Health Line a success. The NSW Ministry of Health had to ensure that its ICT staff had the capacity to manage the implementation and operation of these new technologies, troubleshoot and ensure that this valuable service was operational 24 hours a day, seven days a week. Through the implementation of a State Mental Health Triage Policy, supported by a state-funded telephone triage program, this service has allowed for a consistent approach to the delivery of mental health services.

As with any new design, much effort and thought was given to the testing, monitoring and evaluation of the service. Stakeholders, including the eight Area Health Services (now 15 Local Health Districts), were involved with the development of the service to ensure that

the NSW Mental Health Line would provide mental health professionals with the optimum system for providing a valuable and much-needed service to the people of New South Wales.

- 1 The NSW Mental Health Line aims to streamline the experience for those using a telephone to access specialist help, through the use of geo-location and voice-recognition software. Analyse the effect that this new state-wide number may have had on those working on the previous Area Health Service/ Local Health District telephone mental health services.
- 2 Using the case study of how Information and communications technologies have enabled the development of the NSW Mental Health Line, assess the benefits of the service to the people of New South Wales.



Figure 7.10 The NSW Mental Health Line increases access to mental health services for people anywhere in New South Wales

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## Chapter summary

- Effective communication with clients, manufacturers and target markets is at the core of successful design work.
- Design portfolios document progress through a design process when producing a solution to a design brief.
- Presentations are made by designers to share their work with target audiences.
- Concept sketches are used to explore and document initial design ideas.
- As designs evolve and technical information needs to be communicated, workshop drawings are produced.
- Written communication is an important part of a design portfolio, documenting features such as research and evaluations in detail.
- Successful designers are skilful in oral communication techniques, speaking with clients, other designers and target markets.
- Selecting the most appropriate form of communication for the desired target audience is key to getting the message across.
- Marketing is required to promote a design to the target audience.
- A good marketing strategy includes a combination of advertising methods.

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## Define key terminology

- 1 Communication
- 2 Computer-aided design (CAD)
- 3 Design portfolio
- 4 Documentation
- 5 Information and communications technologies (ICT)
- 6 Marketing
- 7 Prototype
- 8 Sketches
- 9 Stakeholder
- 10 Target audience

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## Chapter summary tasks

- 1 List the key elements of a design portfolio.
- 2 Describe the purpose of a portfolio when developing a solution to a design brief.
- 3 Discuss the value of sketching when developing and communicating initial design ideas.
- 4 Explain the advantages of using computer-aided design (CAD) in communicating a design to a manufacturer.
- 5 Identify the written components of a design portfolio.
- 6 Discuss an advantage of using oral communication over electronic or written forms of communication when researching.
- 7 Explain the importance of marketing to the work of designers.
- 8 Identify five advertising media that may be used to promote the work of a designer.
- 9 Identify three social media websites and/or applications.
- 10 Explain the difference between social media and other forms of online communication, such as email and websites.

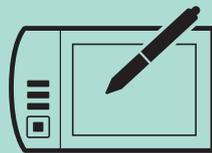
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## Extension tasks

- 1 'Selecting an inappropriate communication technique when presenting to a target market can lead to miscommunication.' Analyse this statement and its significance for the success of design work.
- 2 Propose a marketing strategy for a new social media application for use by young adults on mobile devices. Justify the advertising techniques selected to engage with this target market.

# 8

# Management strategies



## Key terminology

Investigation  
Needs  
Opportunities  
Project management  
Resources  
Time plan

This chapter explores various ways of documenting the management of our design projects. As designers, ensuring that we keep to schedule, within the budget, is critical to the success of our design projects. Failure to manage design projects in the commercial setting could mean a loss of income to the company; therefore project management is vital. There are many different ways in which we manage our time, finance and resources.

In order to develop a clear understanding of the content of this chapter, carefully examine the ‘Students learn about ...’ and the ‘Students learn to ...’ statements relating to **Outcome 5.6.1** in the New South Wales *Design and Technology Years 7–10 Syllabus*.

## 8.1 Project-management strategies

**Project-management** strategies when implementing and evaluating a design process ensure a successful final system, environment or product. As skilled designers, it is important that you:

- prepare and implement time and action plans in design projects
- estimate financial costs in design projects
- manage materials, tools and techniques when developing the design project
- evaluate the role of project management when developing the design project.

When you are developing your project, it is important that you use a number of different management strategies, such as:

- time plan
- production plan
- resource list
- finance plan

- risk assessment
- areas of investigation.

Consideration of the tools, techniques and materials you will use will ensure that you also complete your project successfully by the due date, as you will have considered all possible options for producing your project while keeping within budget.

It is also essential that you evaluate your management tools so that if you were to do this project again you would know what aspects worked and what aspects you need to improve.

### Design brief

The first step in managing a project successfully is to identify the needs and opportunities of your design brief. Identifying, exploring and researching these **criteria** will ensure that you are on track for the rest of your project.

### project management

a responsibility for planning, organising, controlling resources, monitoring timelines and activities, and completing a project to achieve a goal that meets identified criteria for judging success

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### criteria

standards by which a design project may be judged or decided



Figure 8.1 Clearly identify the needs and opportunities of your project.

**Identification of needs and opportunities**  
It is important as a designer that you are aware of the need.

- Why are you developing this product?
- Who is your target market?

Identifying the need will help you in developing your product. Once you have identified the need, you must consider the opportunities and/or **limitations** you may encounter. The design brief is an outline of what you intend to achieve.

The opportunities may be a chance to design something new or to develop new experiences and skills. The limitations are factors the designer must consider that may hinder or slow down the design process. Time, resources available and skill are examples of limitations. The designer must list and describe the opportunities and limitations they could possibly encounter in relation to the need.

At school your teacher will provide you with a detailed design situation. It is important that you are familiar with the context that you are

working with and then rewrite the brief in your own words so that you are very clear on what you will be designing.

Include some of these points in your own rewrite of the brief:

- the technology you are working with
- the name of the unit
- the product/system or environment you will be producing
- the materials you will need to develop this product
- any special instructions that you must follow
- tools or techniques that need to be implemented in the project
- the time frame.

Here are some examples of limitations:

- budget
- school constraints (e.g. equipment, tools, techniques)
- brief constraints
- skill level.

Here are some examples of opportunities:

- the possibility that your product may solve a problem
- opportunity to learn new skills
- opportunity to use new equipment.

**limitation**

a restriction or rule that prevents progress

**design brief**

Over the next 14 weeks, I will be working with wood technology to design and create a storage device for items that I treasure dearly.

- Time: I will have only 14 weeks to work through the design process and make my product. This will impact my project, as I need to ensure that my design is simple while still meeting the brief, as I don't have enough time for detailed designs.
- Skills: I have limited skills in the woodwork room. I have only used a scroll saw in the past, so that will limit me in my design.

The following opportunities will be made available to me:

- Creation of a new item: I will be able to develop a storage solution for my very messy room. All my small items will be stored away safely.
- Use of new equipment: My skills of using the software package Illustrator and my prior knowledge of the scroll saw can be incorporated in this design.

Figure 8.2 An example of a design brief



## 8.2 Time and action plans

Once the design brief has been analysed, this will assist in the development of a time and action plan. These plans should be developed in consultation with one another. There is no point in identifying the steps of the design process that need completing without assigning the time that each step will take. Ensure that you identify realistic and achievable measures. Ongoing evaluation of your time will ensure that you can see what adjustments you will need to make.

### Time/action plan

Using programs such as Microsoft Excel is a great way of documenting your time. Showing proposed times and then actual times is very important. Time plans must have all proposed

times completed prior to the commencement of your design process.

Remember that you colour in the top row when you *propose* to do the work and then when you have *completed* the task you colour in the next row. You will then complete an evaluation that explains the **discrepancy**.

The actions must be written in detail and be specific to your project. The more details you include, the more accurately you will be able to track your time. The production can be blocked as a set time (e.g. three weeks), but the steps in production can be further refined and outlined in your production plans.

Figure 8.3 shows an example of a time/action plan for the start of a project.

**discrepancy**  
an instance of inconsistency or difference

TIME/ACTION PLAN									
TERM 4									
Step	Action	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8
1	I will identify and explore my need by writing up a detailed design brief.	■	■	■					
	Discrepancy								
2			■	■	■				
	Discrepancy								
3					■	■			
	Discrepancy								
4							■	■	

Figure 8.3 An example of a time/action plan

### Production plan

The production plan details the specific steps you take in the making of your product, system or environment. Each step is described in detail. Don't just list the steps; identify the tools

and techniques, and the safety considerations that you must consider. Again, you must complete the plan before you start your production.

Table 8.1 An example of a production plan

Step	Processes	Tools/techniques	Safety issues
1	Create a template of my design on a piece of white paper and then trace this design onto my silver.	Paper, pencil, ruler, tracing my design onto the silver	Ensure that I don't drop the silver onto my foot, as it is quite heavy and I may injure myself.
2	Using the hand-held saw, check that the blade is in the correct way and it is tight. Then, using the up-and-down motion, begin to cut into my silver. Remember to take care and not force the blade.	Silver, hand-held saw, blades, V-peg and clamp. Sawing through the silver is the technique I am going to use.	Ensure that I am wearing my apron and goggles. Ensure that I carry the blade facing downwards when I am moving around the room and ensure that I cut away from my body. My fingers should be clear of the blade at all times. The V-peg must be clamped securely to the table to ensure that my piece does not dislodge and hit me in the face.

## ACTIVITY 8.1

As a class, debate the following statement: 'Time and action plans are only necessary for students.'



Figure 8.4 Planning a project

## 8.3 Estimating financial costs

There are a number of costs in designing. These can slowly creep up if you do not keep a close eye on this. Careful planning is required through a finance plan.

### Finance plan

For a finance plan to be effective, you must begin with outlining your budget and how you have come to this amount. You need to justify how you will be paying for your materials. Proposed and actual costs need to be outlined and you need to ensure that you keep all your receipts. The finance plan must be evaluated and discrepancies need to be justified. Using Microsoft Excel is a great idea, as it will even add up for you the total amounts. See the example below.

#### My budget

My budget for this project is \$100. My parents have decided to contribute \$50 towards my project and I will fund the other \$50 through my part-time job. Therefore it is very important that I stick to my finance plan because ...

#### Finance plan

Item	Proposed cost (\$)	Actual cost (\$)	Justification of difference
<b>Materials</b>			
Silver	30	42	I got 12 mm thick silver, as it is more durable and cuts better.
Beads	25	12	
Chain	12	8	
Solder	2.5	2.5	
<b>Tools</b>			
Saw	13	11.5	
V-clamp	5.5	5.5	
Gas	47	32	
<b>Total</b>	<b>135</b>	<b>113.5</b>	

Figure 8.5 An example of a budget



Figure 8.6 It is important to plan financial decisions and work to a set budget in order to avoid overspending.

## SmartCup

The SmartCup is a reusable and eco-friendly coffee cup that fuses design, form and function with sustainability. It features a double-walled thermo-plastic outer layer that keeps coffee hotter for longer, and high-quality recyclable materials that are stain and odour resistant, BPA-free and non-toxic; has a spill-resistant design; and is entirely dishwasher-safe.

But the most impressive aspect of the SmartCup is its unique smart chip feature, which provides users a quick and easy way to pay for their coffee; all that's required is a swipe of the lid. Frank Green developed a world-first app, CafePay, to facilitate the function.

- 1 Discuss why the designer of the SmartCup would have developed a finance plan.
- 2 Outline how the SmartCup innovation has streamlined payment for coffee.
- 3 Describe, in detail, how the SmartCup addresses the factors of function, aesthetics, ergonomics and environment.



Figure 8.7 Smart Cup from Frank Green

## 8.4 Managing materials, tools and techniques

The resource list identifies and justifies the ideas and resources that will be used throughout the design process. You must provide a detailed outline of all resources, tools

and techniques, and justification for how you will use these and why. Photos can act as a visual aid in this section.

Table 8.2 A detailed outline of resources used on a school project

	Reference	My research suggests	Justification of use/ application and value
Human Experts Teachers	Teacher: Blue, Miss. 15 May 2009. [Pers. Comm]. Northwest New South Wales.	Miss Blue was a great help, as she showed me the correct technique for inserting a blade into the hand-held saw.	I will definitely be using this technique in the development of my project, as it will ensure that I can cut accurately and safely.
Non-human Ideas Books Textbooks	Book: Kimura, S. 2004. <i>Bags with Style</i> . Iola, WI. Krause Publications.  Print encyclopedia: Rosenthal, E. 2001. 'Discrimination'. <i>Grolier Academic Encyclopedia</i> , Vol. 6, p. 190.  Magazine/newspaper: Morley, J.C. (2008). 'From top to elegant toe'. <i>Essential Living, Sydney Morning Herald</i> , 28 February 2008, pp. 14–15.		
Internet	Prints Charming. 2008. Prints Charming Homepage. [Online]. Available at: <a href="http://www.printscharming.com.au/">http:// www.printscharming.com.au/</a> [Accessed: 22 October 2008].		

To assist in managing your resources (materials, tools and techniques), you will need to complete some research in this area. In the project-management section of your folio, it is vital that you outline what you intend to research.

### Areas of investigation

In this section, you must describe the materials, tools, techniques and design ideas that you will need to investigate for your design project to be successful. You need to provide detail on how you will investigate each of these areas. See the example in Table 8.3.

Table 8.3 An example of recorded areas to investigate

	Area to investigate	How I will investigate (primary sources, secondary sources, experimentation)	Justification of use
<b>Design ideas</b> This research will assist me in developing ideas for my project and investigating what is currently on the market.	Research existing trends on the market, such as bohemian and gypsy jewellery	I will conduct an observation at current jewellery stores, such as Sportsgirl, Diva, Equip and Mimco. I will observe what colours, styles and price ranges people are buying.	
<b>Materials</b> The research on materials will ensure that I am using the best material to suit my design brief and ensure that I consider areas such as cost, function, durability and finish.	I will investigate beads as a possible material to be used in my necklace and to see how much it will cost per glass bead.	I will go to Bead Shop in Newtown and research the cost of beads, both glass and plastic, as well as different sizes and colours.	
<b>Tools</b> The research on tools will ensure that I am using tools correctly and safely and that I am using the tools that best suit my adornment.	I will need to research the following cutting tools: hand-held saw for cutting silver and also tin snips for cutting silver wire and solder.	I will use the book <i>Jewellery Fundamentals of Metalsmithing</i> by Tim McCreight.	
<b>Techniques</b> Researching techniques will allow me to explore different types of techniques, decorative or functional, that I could incorporate into my project and ensure that it is completed to a high standard.	I am going to research the following joining techniques for attaching my silver: soldering, fusing, casting, rivets and adhesives.	I will use the book <i>Jewellery Fundamentals of Metalsmithing</i> by Tim McCreight.	
<b>Experimentation</b> Experimenting will allow me to determine which are the best tools, materials and techniques for my project without ruining my final design.	I will be conducting the following experiments: soldering, cutting, annealing, drilling, buffing and polishing. I will need to experiment with all of these techniques, as I want to have the best finish for my design.	I will experiment with all of these techniques in C4 and I will probably use these techniques in the production of my silver ring. All experiments will be written up: Aim, Method, Result and Conclusion.	

## Research and exploration

As designers, it is important that we research and experiment with all potential materials, tools and techniques. From this research we will be able to choose the best materials, tools and techniques to produce a successful end product.

In this section, you will need to document all the research that you have completed.

## ACTIVITY 8.2

Refer to your own areas of investigation (AOIs) to see what you said you would research and use this as a checklist each time you complete an area of research. Complete a table like the one below for AOIs.

Area to investigate	How I will investigate (primary sources, secondary sources or experimentation)	Justification – why I need to research this area
Materials		
Techniques		
Tools		

Areas you may research for your project include:

- design ideas – areas of inspiration, colours, other products on the market
- materials – possible materials that can be used in the development of the product; research a number of materials and their properties, provide ample experimentation and testing, and justify the best possible solution
- tools – possible tools that can be used in the development of the product; research a number of tools, provide ample experimentation, and justify the best possible solution
- techniques – possible techniques that can be used in the development of the product; perform a number of techniques, provide ample experimentation (through sample pieces and prototypes), and justify the best possible solution.

**concise**  
brief and clear

Remember:

- All research must be **concise** and relevant.
- All research must be annotated, summarised and conclusions drawn.
- Use a wide range of sources – do not just print information off the internet!
- Source and acknowledge all information.
- After each of these sections (design ideas, tools, techniques and materials), complete a brief summary on how it meets the need.



Figure 8.8 Make informed decisions through research and experimentation.

## Experimentation and testing

Experimentation and testing will assess the suitability of design ideas by testing and

experimenting with tools, techniques and materials. This will assist you in refining your design ideas and ensuring the final product is of the highest quality.

Table 8.4 Recording your experimentation

<b>Aim</b>	To experiment with the technique of soldering
<b>Method</b>	<ol style="list-style-type: none"><li>1 Put on my personal protective equipment (PPE) – apron, hair tied back and leather shoes on.</li><li>2 Ensure that my ring is clean, and paint flux on the area of the ring that is to be joined.</li><li>3 Using the tin snips, cut a small piece of hard soldering the length of the join and then place it on the join.</li><li>4 Using the third arm, place the ring in the grip and light the blowtorch.</li><li>5 Using a circular motion, heat up the surface of the ring. Then, using a back-and-forth motion, heat the solder. When it ‘sparks’, turn off the blowtorch and place the ring into a bath of cool water.</li><li>6 Place the ring in pickle solution and then rinse with water.</li><li>7 The ring now needs to be sanded and polished.</li></ol>
<b>Result</b>	I successfully soldered my ring together. It was a simple process. The join in the ring is strong, and once my piece is sanded it will look very professional. I would rate my skill level as 8/10. If I were to do this again, I would move slower on the back-and-forth motion to ensure that the solder doesn’t run as far down the ring, as I now have to file this excess solder off, which is kind of a waste.
<b>Conclusion</b>	I will definitely use this process in the final adornment piece, as I am connecting two squares of silver together and, because it is a professional piece that is going to be used for retail, it must be completed to a high standard. It also needs to be durable, and when I tested the durability of the ring it was quite high. Therefore, in terms of aesthetics and durability, soldering is the best option for my final design piece.

## Identifying tools, techniques and materials

When using particular tools, techniques and materials, designers must identify the techniques

they are using. Take a furniture designer, for example. A range of appropriate fittings and hardware, such as hinges, handles, catches and locks, could be used for your production.



Figure 8.9 Furniture makers

## ACTIVITY 8.3

- 1 Imagine you are a furniture designer. Copy and complete the following tables with descriptions and drawings of relevant techniques and hardware.

	Technique	Description	Drawing
Cutting	Scroll sawing		
	Drilling		
Shaping	Filing using files and wood rasps		
	Drilling		
	Sanding (disc sander and sandpaper)		
	Routing		
Finishing	Puttying		
	Oiling and staining		
	Painting		
	Varnishing		
Joining	Butt join		
	Mitre join using V Ezzey		

	Description	Drawing
Hinges		
Handles		
Nails and screws (different types)		

2 Describe the characteristics of the following types of timber using the table below.

Type of wood – description	Examples of use
Softwood: • Hoop pine • Radiata pine • Cypress pine	
Hardwood: • Black bean • Spotted gum • Red cedar • Queensland maple	
Particle board	
Veneer	
Plywood	
Medium-density fibreboard	

3 Complete the following table with descriptions and drawings of some of the tools needed in furniture design.

	Tool	Description	Drawing
Marking and measuring	Ruler		
	Measuring tape		
	Square		
	Gauge		
Cutting	Hand saw		
	Tenon saw		
	Mitre box		
	Scroll saw		
Joining	Finger jointer		
	Biscuit joiner		
	Hammer/screwdriver		
	Portable drill		

## Documentation of the realisation of design ideas

### Final product specification sheet

Documentation of which tools, techniques and materials are used is crucial in the project management of a design. A product

specification sheet ensures that you have identified all the resources that were used to develop the final design (after all your research).

An important question to ask is: Does my product meet the need?

Complete a product specification sheet (see Table 8.5) for your own project. You can cut out samples of your wood, fabric and so on and

place it in the materials used section. Describe each item – do not just list them.

Table 8.5 Product specification sheet

Product name	
Relationship to need: • What need does your product fulfil? • How did you ensure you met this need?	
Tools used	
Techniques used (both decorative and structural techniques)	Decorative
	Structural
Materials used (include extras, such as knobs, hinges, dowels)	
Photo/sketch	

## 🔍 CASE STUDY ANALYSIS 8.2

### Greentom stroller

Greentom’s mission is to create 100 per cent green products. To color the world and the future of our kids a little (okay, preferably a lot) greener. We believe less is more. It starts at the drawing table by optimising all product parts. It ends with the most comfortable, sustainable and affordable stroller on the planet.

- 1 Describe why it is important for Greentom to research and experiment with the materials, tools and techniques used in the development of the stroller.
- 2 Discuss how the Greentom stroller addresses social issues.



Figure 8.10 Greentom strollers are built with sustainable materials.

## Emma Chegwyn

Emma Chegwyn is a designer who works with concrete. An industrial designer by trade, Emma is an emerging designer in both the making and styling sectors of the design industry, having studied both in Sydney and Italy. Gaining in-house hands-on experience in a number of Sydney-based design and manufacturing companies, she has also developed her interest in product photography and styling through a placement with a leading Australian lifestyle magazine. Emma has taken the initial skills and enthusiasm learned through studying Design and Technology in high school, and seeks to implement them in the various design processes she undertakes both in the industry and educationally.

The following project description is from when Emma was employed as a freelance designer supplying and wholesaling concrete cups to an Australian homewares brand.



Figure 8.11 Emma Chegwyn

### Brief

There is always a brief and the intended outcome becomes clear to the designer. It need not relate to a specific problem or context, but rather the brief can equally be specific in pertaining to an identified aesthetic and functional outcome. *In the instance below, the brief is established as to make and finish*

*a batch of concrete cups for design wholesale in a well-known Australian design store. These concrete accessories will then be used for a multitude of purposes, such as desk and jewellery storage, succulent and cactii pots, window displays and candle holders, to name a few. The brief is short and succinct. The desired outcome has been established.*

### Budget

Expenditure relating to the project needs to be managed from commencement. Coming in at, or under, cost is ideal with any design process. Working out the most cost-effective way of repeatedly manufacturing concrete cups was a large component of my design process, for it then determined the wholesale cost of the product, and consequently the percentage that I gained. *The lower the cost, the greater the profit margin.*

### Criteria to evaluate success

Specifically, aesthetics were key to the success of the cups. They were driven by a brief that focused on the visual characteristics of the product more than it valued other elements such as life-cycle considerations. This was primarily due to the understanding that the end product was being targeted at a market that placed higher value on the aesthetic and decorative look of the goods as opposed to any related environmental concerns involved. Should the use of energy and the recyclability of both the inputs and outputs surrounding the concrete cups have been analysed, for example, costs at both ends of the design and sale process would have been affected. For a good that was designed to be sold with as great a margin as possible, this was not necessarily attainable within the time frame and budget costs to which I was restricted. *For emerging designers, a common vision for success is that of considering sustainability within design. However, when faced with industry realities and deadlines surrounding time, expenditure, materials and product turnaround, creating the 'perfect' product that successfully meets all CTES becomes difficult to achieve and a fast learning curve to negotiate.*

## Areas of investigation

Research must be pertinent to the brief at hand. In this case, the AOI related to manufacturing techniques and methods. This was investigated by conducting primary interviews with other makers that were familiar with small-scale concrete manufacturing, in order to determine my own process method, with the materials used a key component of this investigation. Many existing concrete designs use a pre-made combined mix, whereas I found, through investigation and research, a better finish was achieved through making the mix myself with sand and cement, which further benefited the design in aiding in the structural integrity and thus functionality of the finished goods. Below is a list of the final materials used:

- 20 kg Sydney Wash Sand
- 20 kg General Purpose cement
- Crommelin Water Based Paving Sealant
- 80 and 180 grade sandpaper
- large flexi tub – 50 L or larger is ideal as the container to mix the cement in
- 450 ml plastic cups, and 200 ml plastic cups to use as moulds
- pebbles/small rocks to use as weights in the smaller cups
- masking tape
- spray paint – in colours of your choice.

Other areas of investigation pertained to the decorative aspect of the cups, concerned with existing products on the market and ways in which I could differentiate the cups I was responsible for.

## Research

A key component of the design stage is researching the necessary **personal protective equipment (PPE)**. When working with cement, always wear the correct protective clothing as it is an alkaline substance in its fine powder form:

- long gloves – to guard against skin irritation
- face mask – to prevent dust inhalation
- eye protection – to prevent dust from getting into eyes
- long pants and sleeves – to guard against skin irritation
- safety boots – to prevent injuries to your feet when handling heavy items or using potentially hazardous tools.

Always wash clothes that may be splashed with cement-based products separately at the end of each day.

*In an industry setting, research becomes increasingly based on tangible experimentation.*

Trial and error is a key form of research in the design process, and was a large contributor to the success of the concrete cups. For every batch that was manufactured, there were imperfections and mistakes to be learned from, first-hand research that otherwise cannot be obtained.

## Production

Prior to production, final production specifications are realised in the form of a product spec sheet, both formally and informally. The spec sheet in this instance detailed the minimum volume of the initial concrete pour, which then determined the quality of the cup groove, a key aesthetic requirement that separated a marketable cup from a non-marketable one. Other specifications included the placement of the inner mould, the order in which pre-production and post-production procedures must be followed, the types of moulds needed for standardised product measurements, and specified materials required that were determined through the research stage to give the best quality results.

Below is my production process for making concrete cups.

- 1 Stir the cement and sand mix in with the water until a yoghurt-like consistency is reached. The amount of water added will be dependent both on the maker's discretion and the recommendations on the cement packet. The stirring process may take a while; however, it is important to follow through so that there is an even consistency of sand, to cement, to water in the final moulds.
- 2 Once the consistency is reached, pour the cement into the 450 ml cups two-thirds of the way up, and leave to sit for 5–10 minutes. This resting stage is critical, as it allows the cement to begin to set, making the placement and positioning of the second, smaller mould, a lot easier.
- 3 Place the 200 ml cups (with the pebbles inside used as weights in order to keep

### personal protective equipment (PPE)

equipment used or worn by a person to minimise risk to the person's health or safety; for example, goggles, ear muffs, face shield, hard hat, apron, gloves

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the cup in place) in the centre of the larger cups. This stage will require further monitoring for the following 10–15 minutes, while the cement begins to harden, in order to ensure that the inner moulds can be adjusted and sit to stay centred (or off-centred, dependent on the maker's choice).

- 4 Leave to sit for a minimum of two days. For the best results, the ideal resting time is anywhere between four and seven days.
- 5 Remove the inner moulds by pouring out the weights and cutting one side of the cup (taking care not to scratch the concrete) to release and pull out the plastic. Do the same with the outer mould, by making a small incision and then peeling off the cup.
- 6 Using the sandpaper, sand down any imperfections on the top of the cups until an even rim is achieved.
- 7 To protect against moisture, water and greasy substances, it is recommended to lightly seal the cups by dipping a cloth into the sealant and brushing over the concrete.
- 8 After 24 hours from the time of sealing, the cups will be ready to decorate. Using masking tape to create a stencil shape of the desired painted area, lightly spray 2–3 coats of paint and leave to dry.

### Evaluation

Following manufacturing and production, the first step is to go back and assess whether the finished product meets the brief. *Are the cups sellable firstly for wholesale and secondly for customers? Do they meet the aesthetic requirements? Are they functional as intended?* The evaluation stage is often where the most knowledge is gained. It is here that improvements in both material choices and production steps can be made.



Figure 8.12 Nearly half a batch of 70 cups were unable to be used as they didn't meet product requirements. These are some of those initial cups.



Figure 8.13 Finished cups that have been left in their moulds for nearly a week



Figure 8.14 Final products with the painted designs

- 1 Draw a flow chart of Emma Chegwyn's design process.
- 2 Describe the tools, techniques and materials she utilises in making her products – use the templates shown earlier in this chapter.
- 3 Analyse the factors affecting design and production of her concrete items.
- 4 Discuss the importance of a budget and research for Chegwyn's products.



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## Chapter summary

- Project-management strategies when implementing and evaluating a design process ensure a successful final system, environment or product.
- Designers need to be aware of the need. Key questions to ask include: Why are you developing this product? Who is your target market?
- For a finance plan to be effective, you must begin with outlining your budget and how you have come to this amount. You need to justify how you will be paying for your materials.
- Experimentation and testing will assess the suitability of design ideas by testing and experimenting with tools, techniques and materials. This will assist you in refining your design ideas and ensuring the final product is of the highest quality.
- The resource list will identify and justify which ideas and resources will be used throughout the design process.
- The areas of investigation section outlines the materials, tools, techniques and design ideas that you will need to investigate for your design project to be successful.
- A product specification sheet ensures that you have identified all the resources that were used to develop the final design.
- As designers, it is important that we research and experiment with all potential materials, tools and techniques. From this research we will be able to choose the best materials, tools and techniques to produce a successful end product.
- All research must be concise and relevant. All research must be annotated, summarised and conclusions drawn.
- The production plan is specifically the steps you take in the making of your product, system or environment. Each step is described in detail.

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## Define key terminology

- 1 Investigation
- 2 Needs
- 3 Opportunities
- 4 Project management
- 5 Resources
- 6 Time plan

---

## Chapter summary tasks

- 1 Describe the importance of employing project-management strategies for all design projects.
- 2 Outline why it is important to identify your target market in your needs analysis. Explain the implications this may have on the success of your final product.
- 3 Describe the role of experimenting and testing in the design process and the impact on the quality of the final product.
- 4 Discuss emerging technologies (e.g. laser cutter, heat press, embroidery machine, Baby Lock, hemming machine) that you have used in one of your design projects this year. How did it impact on your design and production?
- 5 Explain the impact that research and experimentation have on the success of the final product.
- 6 Find five products on the market that inspire you. Complete a plus, minus and interesting (PMI) chart for each.
- 7 Why is it important to consider environmental and sustainability issues when designing a new product?
- 8 'Evaluation only happens at the end of the design process.' Discuss this statement.
- 9 Discuss the importance of a time and action plan, criteria to evaluate success and evaluations in the design process. Include specific examples to clarify your discussion from design projects you have completed this year. (Write a detailed paragraph for each factor listed above.)

10 In a table like the one below, complete a PMI chart about the SmartCup (see page 136) and its impact on society.

Positive	Minus	Interesting
•	•	•
•	•	•
•	•	•
•	•	•

## Extension tasks

### A pencil that doubles as a stylus!

Don't be fooled by its appearance; this is not your everyday pencil. One end can be used to draw or write on paper, while the 'eraser' is your very own stylus. The tip is made from ECR (Electro Conductive Rubber), which will work on your smartphone, tablet and a range of other devices.

- 1 Describe how you have used computer technologies in a design project this year. Identify computer programs you may have used.
- 2 Describe how new computer technologies have helped designers in documenting their design process. Include specific examples based on your projects this year.
- 3 How have emerging communication technologies changed the way designers interact? Use examples to support your answer.

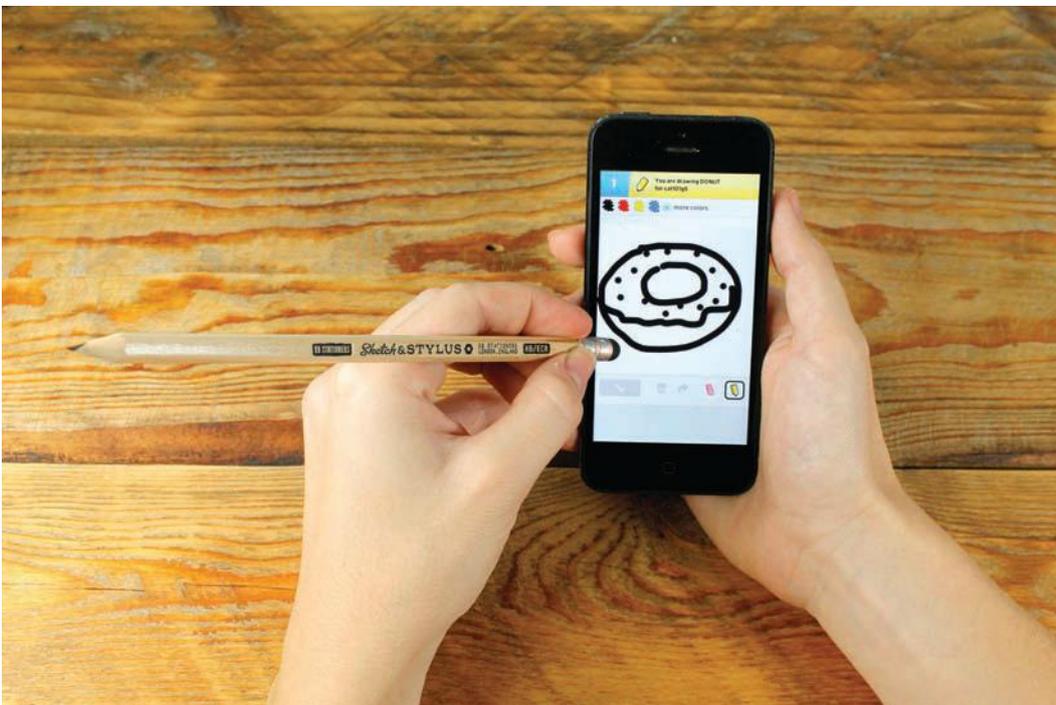
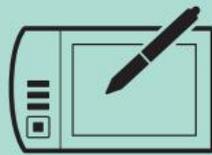


Figure 8.15 The stylus pencil

# 9

## Risk-management practices



### Key terminology

**Discrimination**  
**Equal employment opportunity (EEO)**  
**Hazard**  
**Job safety analysis (JSA)**  
**Legislation**  
**Personal protective equipment (PPE)**  
**Risk**  
**Risk assessment**  
**Safe operating procedure (SOP)**  
**Work health and safety (WHS)**

This chapter explores hazards in the practical classroom and how the risk they present can be managed. The identification, assessment and control of any hazards in the practical classroom are an essential part of learning in Design and Technology. Knowledge of this process is required not only to be a safe learner, but also to produce the best possible solutions to your design briefs. Safe work practices used in schools are modelled on those used in the workplace, giving students lifelong skills for entry into the workforce.

In order to develop a clear understanding of the content of this chapter, carefully examine the ‘Students learn about ...’ and the ‘Students learn to ...’ statements relating to **Outcome 5.6.2** in the New South Wales *Design and Technology Years 7–10 Syllabus*.

## 9.1 Risk management

Design and Technology is a practical course and when participating in practical work, **risk** to ourselves and those around us is ever-present. Risk can be defined as a situation that may expose someone to danger, harm or loss. For example, when using a saw users are at risk of slipping and cutting themselves if their work is not secured properly. As a result, it is essential that everyone take the necessary steps to ensure that no one is exposed to harm. The right to work safely is covered by law in Australia, and this is explored later in this chapter.

While working safely in the practical classroom is essential in Design and Technology, it is also important to consider the safety requirements for all stakeholders when producing solutions in response to a design brief. Not only must the processes of production be safe, but the design itself must be safe for use by the intended target market. An example would be making sure that a child's toy does not have any small parts that may break free and become a choking **hazard**. Consideration should also be given to the safety of those who come into contact with the product once it is no longer useful and becomes waste; for example, the use of hazardous materials that may become a risk to others when being disposed of in common garbage systems.

### Risk assessment

Before any task is undertaken, a risk assessment must be conducted. This may be for the project being made, the workshop being used or the individual tools and machines required.

During this process, an analysis is done of any possible hazards that may cause an accident, and the likelihood of the accident actually occurring is estimated. For example, during a practical lesson someone is more likely to hit their finger with a hammer than receive an electric shock from a power tool. Following the identification of possible causes, the level of the injury and treatment required is also estimated. Hitting a finger with a hammer is most likely to be a minor injury requiring first aid; an electric shock may be a serious injury leading to disability or even death. Good risk-management plans will also identify any control measures to reduce the chance of the injury occurring. Accidents such as hitting a finger may seem unavoidable, but good training and appropriate use of the tool will always help to reduce the likelihood. In the example of electrical shock and a greater level of possible injury, a higher level of control measures will be required, including inspection before use, regular electrical testing

#### risk

a situation that may expose someone to danger, harm or loss

#### hazard

something that is potentially very dangerous

	Very likely	Likely	Unlikely	Very unlikely
Death or disability	1	1	2	3
Long-term injury	1	2	3	4
Medical attention	2	3	4	5
First aid required	3	4	5	6

#### Risk level key:

- 1 and 2 – **High risk**: Immediate action to control the risk is required before work can begin.
- 3 and 4 – **Moderate risk**: Immediate short-term control is required before work begins, with a plan for a long-term solution.
- 5 and 6 – **Low risk**: Attention is required in a reasonable time frame to control the risk.

Figure 9.1 A risk-assessment matrix

and tagging by professionals, training and appropriate use.

To assist in the assessment of the degree of risk posed by an identified hazard, a risk-assessment matrix is used. Set up by organisations to suit the type of work they are engaged in, the matrix is a table that considers the level of potential consequence of an accident and the likelihood of an accident happening due to the hazard. When reading the matrix, compare the consequence with the likelihood for the identified hazard and determine its severity. The matrix will then advise on the level of risk and the appropriate measures to take to manage it.

### Controlling risk with the risk-control hierarchy

We are able to control these risks through the application of a system called the risk-control hierarchy. The aim of this is to help those managing risk to minimise or eliminate exposures to hazards. There are six steps in the risk-control hierarchy, from the most effective to the least effective, and these are applied depending on the level of risk.

- 1 Elimination:** Physically removing the hazard is the only way to ensure that it is no longer a risk to those who would come in contact with it. In a practical classroom, this may be removing a dangerous machine from the workshop that is not required.
- 2 Substitution:** Swapping the hazard for something safer is a good way to reduce risk. For students, this could be using water-based lacquer on timber instead of an oil-based finish, or a cordless tool in preference to a corded power tool.
- 3 Isolation:** When something is not needed, it can be controlled so that it cannot be used. An example of this is a power isolation switch in a practical classroom. The power to machinery can be isolated so that it cannot be turned on when not required, such as when a teacher needs to stop practical work to give safety instruction to the class.
- 4 Engineering:** The fourth most effective control measure involves a technician modifying the equipment that is hazardous. In a practical classroom, this includes dust and fume extraction, such as that used on a laser cutter.



Figure 9.2 Documentation and review are an important part of a risk-management process.

- 5 Administration: Administrative controls are rules put in place by a school or education department for how tools, machinery and equipment should be used when conducting practical work. This includes safety testing and instruction, signage and teacher supervision.
- 6 Protection: The use of personal protective equipment (PPE), such as safety glasses, aprons and enclosed leather shoes, is the final control measure used to minimise the risk of injury. This is implemented when other levels of the hierarchy are not practical.

Once hazards have been identified, assessed and controlled, good risk management continues with a monitoring process. The process should be documented and reviewed on a regular basis to ensure that the risk of the hazard occurring remains minimised for those working in the classroom. Identifying possible hazards, determining the level of injury they may cause and implementing control measures before the commencement of work are essential to managing risk within practical classroom spaces.

## ACTIVITY 9.1

Due to the practical nature of the Design and Technology course, at times you will need to use a range of different tools and machines as you produce solutions to design briefs.

For a tool or item of machinery nominated by your teacher, conduct a risk assessment of any potential hazards that may result from its use. Use the risk-assessment matrix to determine the level of risk and document the assessment using a table like the one below.

Risk-assessment form				
No	Hazard	Injury	Risk level (1–6)	Controls
1				
2				
3				
4				
5				

## 9.2 Safe work practices and safe environments

### Planning for safe work

Planning is an important part of safety in the school workshop. Being well prepared and organised is just as important as being able to read workshop drawings and knowing how to use tools and machines safely. A procedure is often used in Design and Technology classes to plan out what needs to happen. This is a description of each practical step needed to complete a project that includes the tools and techniques required to do so.

As a risk assessment is used to identify and manage hazards for individual tools and machines, a job safety analysis (JSA) is an industry tool that formally documents the safety analysis of a project where a greater level of risk exists. As with a risk assessment, the scaffolding a JSA provides helps us look at the tasks we are required to complete in order to finish a project in the safest possible way.

The process for completing a JSA is as follows:

- 1 Identify the project to be undertaken.
- 2 List the steps required to complete the project. This includes any tools or machines required for each step.
- 3 Identify the hazards that may occur while using the tools or machines for each step. Reviewing risk assessment and safe operating procedures (SOPs) will help with this step and step 4.
- 4 List the controls that will be put in place to eliminate or minimise the risk.
- 5 Identify who is responsible for the controls. It may be the user wearing PPE or it may be the teacher checking that all required guards are in place.
- 6 Review the JSA as you work through your project to ensure you are adhering to your plan, and update it as required; for example, if additional hazards are identified, add them to your JSA.

Table 9.1 Job safety analysis (JSA) form

Name:		Date:	
Project:			
Step:	Hazard:	Control:	Person responsible:

In the workplace, a JSA is used to document the safety planning process. In the event of an accident, an employer will be asked to produce the JSA as proof that a hazard identification and control process was being used, along with other evidence of risk management and supervision. For high-risk work in industry, a safe work method statement (SWMS) may be used.

### Contributing to a safe working environment

Being able to work safely in the school workshop, as with any workshop, is the right of every student. As a result, it is also their responsibility to work safely. For students in a Design and Technology workshop, this includes:

- Engaging in and completing all safety tests delivered by your teacher, be they written or online, making sure that you fully understand the content of the tests and asking your teacher for help if required.
- Actively observing and listening to safety demonstrations delivered by your supervising teacher. As with your safety tests, ask questions if you are unsure about any part of the safe operation of practical equipment or completing a process. Using tools and machinery that you are not familiar with is a source of great risk to yourself and others.
- Following the directions for use as indicated by the SOP for the tools or machinery you are using. Displayed in close proximity to the described tool or machine, the SOP gives vital information about the possible risks, how to manage them through appropriate use and the PPE required.
- Observing the safety signage for your workspace.
  - A sign may indicate that enclosed leather shoes must be worn.
  - Black **pictograms** on a yellow background are a warning of a hazard, such as flammable materials.
  - A red circle with a slash over a black pictogram on a white background indicates something that is prohibited, such as no entry to a storeroom.
  - Blue pictograms on a white background indicate a mandatory requirement.
  - Yellow safety zones marked on the floor around machinery remind students to give space to the machine and its operator when in use.
- Keeping your workspace clean and tidy. Return any tools and materials not in use to their place of storage. Cluttered work benches and untidy rooms are potential hazards.
- Knowing where your nearest first aid station is located, and what your accident reporting process is for your classroom. Most likely there will be a first aid kit in your classroom or nearby, and your teacher will use it to apply basic

first aid if and when required. Accidents of a more serious nature may require referral to your school sick bay or first aid officer.

- Allowing enough time to pack away tools, store project work and clean the practical classroom. Leaving things out at the end of a lesson can lead to damage and also create a hazard for those who use the classroom after you.



Figure 9.3 Workshop safety signage reflects that is used in industry, such as at this construction site.

By establishing a routine for practical lessons that includes these safe working steps, you will not only be contributing to a safe working environment for yourself and your peers, but also giving yourself the opportunity to produce the best possible solution to your given design brief.

**pictogram**  
a simple picture used to describe something

## Workplace health and safety legislation

In New South Wales, the health and safety of employers, employees and visitors to places of work are protected by law. The *Work Health and Safety Act 2011* requires persons conducting a business or undertaking (PCBUs) to consult with those involved with their workplace and collaborate to ensure that everyone is protected from risk.



## SAFework NSW

SafeWork NSW is the state's workplace health and safety regulator. We focus on harm prevention and improving the safety culture in NSW workplaces.

SafeWork NSW offers advice on improving work health and safety, provides licencing and registration for potentially dangerous work, provides testing services, investigates workplace incidents and enforces work health and safety laws in NSW.

Comprehensive work health and safety information is available on the [WorkCover website](#).

### QUICK LINKS

- [How to raise a safety concern](#)
- [Notifying us of an incident](#)
- [Employer and business obligations](#)
- [Safety topics A-Z](#)
- [Licences and notifications](#)
- [Worker and visitor obligations](#)
- [Asbestos](#)
- [Replace a white card](#)
- [TestSafe](#)

[ALL NEWS](#)

[ALL SAFETY ALERTS](#)

[WORKCOVER WEBSITE](#)

Figure 9.4 The SafeWork NSW website (see <http://cambridge.edu.au/redirect/?id=6617>)

**legislation**  
a law passed by an elected government

The *Work Health and Safety Act 2011* is New South Wales **legislation** that took effect on 1 January 2012. It is based on the national model *Work Health and Safety (WHS) Act* developed by Safe Work Australia, following input from all states and territories. Prior to this, each state and territory had its own laws protecting the safety of those in and around work. While many of these laws have been standardised across Australia, the national model also allows states and territories to include their own individualised features where required.

Under Part 2 of the Act, a PCBU must make provisions for its employees' health, safety and well-being by:

- keeping the workplace safe, including providing safe entrances and exits
- providing for the safe use and storage of tools, machines and materials

- making sure the tasks and environment do not cause a risk to the health of the employees
- providing any necessary training so that their employees can perform their tasks safely
- meeting the needs of their employees' welfare by providing any required facilities, such as toilets and meal rooms.

While it is enforceable by law that these provisions are made by employers, workers also have a duty under Part 2 of the Act to take reasonable care of the health and safety of themselves and others. When at work, an employee must:

- take care of their own health and safety
- take care not to endanger the health and safety of those around them

- do what is needed by their employer to help meet the requirements of the Act
- follow the rules and procedures put in place to maintain a safe working environment.

As **consultation** is a key factor in ensuring the success of workplace health and safety, there are a range of ways in which businesses work with all involved to plan a safe workplace. Depending on the size of the business, employers may consult through a health and safety committee made up of stakeholders, employees may vote to nominate a health and safety representative, or they may negotiate to come up with another arrangement. Whichever way a business and its employees decide to go, these committees and representatives play an important role in ensuring that communication between employers and employees is ongoing. This ensures that hazards are identified and controlled efficiently, and the planned welfare and safety procedures are followed and improved as required.

## Monitoring and enforcing WHS legislation

In New South Wales, management of the Act is undertaken by SafeWork NSW (called WorkCover NSW prior to September 2015). SafeWork NSW inspectors have the power to check that businesses, employers and employees are complying with the legislated requirements of the Act. Penalties for breaches of the Act can include:

- fines of up to \$300 000, five years in jail or both for an individual
- fines of up to \$600 000, five years in jail or both for a person conducting a business
- fines of up to \$3 million for a corporation.

Workplace health and safety is not only law, it is also good business practice. When employees are away from work due to illness or injury, or tools and machinery are isolated from use as they are unsafe, the lost time leads to a loss of income for a business. Over the long term, this could lead to a business becoming unviable as well as the loss of employment. With livelihoods at stake, it makes sense for all involved to ensure that accidents are avoided at all costs.

**consultation**  
a meeting with the purpose of reaching an agreement

### ACTIVITY 9.2

Search for an online news article reporting upon a case of the *Work Health and Safety Act 2011* being breached. Remember to refine your search to only return results from Australia, and select a case that has occurred in New South Wales. Once you have selected an article, summarise it by answering the following questions:

- 1 Describe the breach of the Act.
- 2 Identify the location and the key people involved.
- 3 Explain the consequences for those involved.
- 4 Propose a measure that could stop an event like this occurring again in the future.

## Safe working practice at the Canobolas Rural Technology High School

The Canobolas Rural Technology High School is a government school in Orange, New South Wales. It offers a diverse curriculum including a successful Technology education program that features Design and Technology. As with any school, Canobolas has implemented safe working practices for staff and students to follow when working on practical tasks. Practical technology classrooms have been laid out to meet the workplace health and safety requirements in New South Wales government schools, including appropriate spacing between work stations, safe working zones around machinery as indicated by safety lines on the floor and emergency stop systems for electrical equipment. Dust and fume extraction is included for Timber, Metal and Food Technology learning spaces.

At the beginning of the school year, the Technology staff complete a risk assessment of the practical workspaces within the school.

Using a form provided by the Department of Education's workplace health and safety team, staff check to ensure that the classroom and equipment are in good working order, machines are guarded, signage is in place and entries and exits are clear. Anything deemed to be not safe is corrected before lessons can begin.

When planning practical projects for any class, the teacher reviews the prior knowledge and ability of their students and then considers the requirements of the syllabus for the course. Once a suitable project has been selected, the teacher will check the Equipment Safety in Schools (ESiS) document. ESiS provides risk assessments for all power tools and machinery for New South Wales government schools and advises teachers on the safety training and control measures required for safe and appropriate use by students. The Chemical Safety in Schools (CSiS) document is a similar



**Figure 9.5** The Metal Trade Training Centre at the Canobolas Rural Technology High School is an example of a well laid-out practical learning space. Note the safety zones clearly marked on the floor.

resource provided to advise on the use of materials, adhesives and other potentially harmful substances.

Before project work begins, teachers will induct students in safe working procedures for a practical classroom. This will include a demonstration of safe practice, the location of PPE and first aid procedures. Students will complete a test to demonstrate their understanding of what it means to be safe in a classroom. Project work can then commence. During the course of the project, teachers will train students on the safe use of hand tools, power tools and machinery as required. This process is determined by ESiS and often includes a teacher demonstration, teacher observation of safe student use and a written safety test. The teacher will record the date of the training and who was present, and not let

students proceed with the use of equipment until these requirements are met.

Teachers will manage risk in the practical classroom on a day-to-day basis in order to provide duty of care to their students. This is done primarily through active supervision in the classroom. They ensure that the room is free of hazards before work begins, that students are wearing all required PPE and that any unsafe behaviour is quickly corrected. They also expect that all students are working to ensure not only their own safety, but the safety of those around them.

During the school year, when a hazard is noticed by a student, it is reported to their teacher. The teacher will act on the hazard where possible; for example, a trip hazard caused by poorly stored projects. If they are unable to eliminate the hazard, the teacher will report it to the Head of Department. The hazard is then either referred to be repaired within the school maintenance process, or it is referred to the school's WH&S committee and reported to the Department of Education, through the use of a department-provided risk-assessment form.

All schools follow a process for safe work practice, developed so it may suit their location, facilities and students. Analyse the role of well-structured, safe working procedures in a school such as yours.



Figure 9.6 Welding metal requires unique risk-control measures, such as fume extraction and insulative floor mats. These measures complement personal protective equipment, such as a welding helmet, leather gloves and full-length cotton clothing.

## 9.3 Fair and equal opportunities

### discrimination

the unfair treatment of a person or group

### Anti-discrimination legislation

As a worker's health and safety is protected by law, so is their right to not be discriminated against when in the workplace. **Discrimination** is where a person or a category of people has been treated unfairly, such as on the basis of their race or sex.

In New South Wales, the *Anti-Discrimination Act 1977* protects workers by law from being unfairly treated because of:

- their sex
- their race or their age
- having a physical, mental or other disability
- their sexual preference or identity
- being a carer, like that required for someone with a disability
- their marital status.

Discrimination can come in two forms:

- direct discrimination – where the discrimination is made directly to the victim by the culprit, such as refusing employment to a female person for a job with a lot of manual tasks despite her being the best candidate
- indirect discrimination – a practice or policy that may seem fair but actually discriminates against a group (e.g. a requirement for uninterrupted employment treats women less favourably than men).

Having this law in place means that any employer must treat all job applicants fairly, and determine the successful candidate on the basis of individual merit and not personal characteristics. When working, employers and supervisors must do their best to ensure that harassment is not occurring within their team or workplace.

At the federal level, there are a range of Commonwealth laws that protect people

in a range of circumstances from being discriminated against. Some aspects of these Acts overlap with what is protected by the NSW *Anti-Discrimination Act 1977*, and both layers of legislation protect those in New South Wales from being unfairly treated. Commonwealth legislation includes:

- *Age Discrimination Act 2004*
- *Australian Human Rights Commission Act 1986*
- *Disability Discrimination Act 1992*
- *Racial Discrimination Act 1975*
- *Sex Discrimination Act 1984*.

### ACTIVITY 9.3

Search for an online news article reporting on a case of someone being discriminated against that was covered by Australian legislation. Remember to refine your search to only return results from Australia. Once you have selected an article, summarise it by doing the following:

- 1 Describe the act of discrimination that was claimed.
- 2 Identify the location and the key people involved.
- 3 Describe the legislation that gave protection to the victim.
- 4 Explain the consequences for those involved.
- 5 Propose a measure that could stop an event like this occurring again in the future.

### Equal employment opportunity principles

Equal employment opportunity (EEO) principles are in place not only to ensure that all

workplaces are free from all forms of unlawful discrimination and harassment, but also to provide ways by which those in minority groups can overcome past or present disadvantage. These principles are designed to achieve a diverse and skilled workforce, improve employment for disadvantaged groups and build a workplace culture of fairness.

EEO groups are those who have been disadvantaged in the past, or continue to face difficulty trying to gain employment. They are more likely to be unemployed or working in lower paid jobs. These groups include women, Aboriginal and Torres Strait Islander peoples, people with a disability and many ethnic and religious minority groups.

EEO principles are strategies that employers put in place to ensure that they are meeting the requirements for fair employment and are not at risk of breaching anti-discrimination laws. This may include recruitment programs,

including merit selection and targeted positions for new employment, and providing access to training and careers to those within EEO groups in existing positions. By implementing rules, policies and encouraging positive behaviours, employers can create a workplace that is fair for all people. At the heart of all EEO principles is the aim to create an environment where all workers are valued and respected equally, and have the opportunity to reach their potential in the career path of their own choice.

In New South Wales, equal employment opportunity, like anti-discrimination, is covered by state and national laws. In order to encourage EEO in the workplace, the Australian Government provides incentives such as funding for employers to support EEO groups such as people with a disability, Indigenous Australian people, the long-term unemployed and older people.



Figure 9.7 Providing convenient parking spaces is one way a business can make employment more accessible for those with limited mobility.

## ACTIVITY 9.4

Formed in 1986, the Australian Human Rights Commission (AHRC) is an institution funded by the Australian Government. It operates independently from the government and is tasked with investigating matters of discrimination in Australia, including in employment. As a proactive measure, the AHRC provides a range of advice about best EEO practice for business.

Visit the Australian Human Rights Commission website (see <http://cambridge.edu.au/redirect/?id=6618>). Read the 10 steps that the AHRC recommends businesses take to create a fair and productive workplace. Considering the advice given, design a poster that can be used to promote a strategy for fair employment to employees. As a class group, brainstorm ideas for posters from the advice given. Your poster may promote your selected strategy by recommending a positive EEO workplace practice or by highlighting a discriminative practice to avoid.



Figure 9.8 Workplaces should be accessible to people in wheelchairs

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## Chapter summary

- Safety is paramount in the Design and Technology practical workspace, as it is in any workplace.
- Everyone has the right to a safe workplace, and safety is everyone's responsibility.
- Risk management is the process of identification of any potential hazards, before they cause accidents.
- A risk-management matrix is a tool used to assess the potential severity of risk caused by a hazard.
- The results of the use of a risk-management matrix are recorded on a risk-assessment form, along with suggested control measures.
- The risk-control hierarchy advises on the best way to reduce the impact of any hazard.
- A job safety analysis helps us plan to avoid accidents before we commence practical tasks.
- Workplace health and safety is legislated in New South Wales under the *Work Health and Safety Act 2011*.
- In New South Wales, it is illegal to discriminate against someone in the workplace under the *Anti-Discrimination Act 1977*.
- Equal employment opportunity principles are in place to make the workplace fair for everyone.

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## Define key terminology

- 1 Discrimination
- 2 Equal employment opportunity (EEO)
- 3 Hazard
- 4 Job safety analysis (JSA)
- 5 Legislation
- 6 Personal protective equipment (PPE)
- 7 Risk
- 8 Risk assessment
- 9 Safe operating procedure (SOP)
- 10 Work health and safety (WHS)

---

## Chapter summary tasks

- 1 Compare a hazard with a risk.
- 2 Brainstorm a list of 10 possible hazards in your classroom.
- 3 Identify an injury that may take place in a Design and Technology practical workspace.
- 4 Describe the risk-management matrix.
- 5 Propose the most useful time for using a risk-assessment form.
- 6 Describe the process for reporting hazards in your classroom.
- 7 Identify five items of personal protective equipment that you will use in your Design and Technology practical workspace.
- 8 Describe the penalties for an employee if they are found to breach the *NSW Work Health and Safety Act 2011*.
- 9 Explain possible reasons why older workers may be an equal employment opportunity minority group.
- 10 Describe the key features of a safe operating procedure.

---

## Extension task

Displayed in close proximity to the described tool or machine, an SOP gives vital information about the possible risks, how to manage them through appropriate use and the PPE required. Create an SOP for a tool or item of machinery you have used recently. Your SOP should include:

- the name of the tool or item of machinery
- a picture of it to help it be easily identified
- a list of the possible hazards when in use
- advice on how to minimise the risks when in use
- the PPE required to safely use the item.

# 10

## Selecting and using a range of technologies



### Key terminology

Appropriate  
Criteria  
Designing  
Document  
Equipment  
Evaluation  
Justify  
Materials  
Multimedia  
Peer assessment  
Producing  
Reflect  
Requirements  
Self-assessment  
Success  
Techniques  
Tools

This chapter explores a range of tools and equipment, materials and techniques, their selection and use, and the requirements for designing and producing. It discusses the selection and use of a variety of appropriate techniques when designing and producing and how to document and evaluate decisions made throughout the design process using specified criteria for success. The chapter continues to address self-assessment and peer assessment on designed solutions and looks at how to reflect on students' learning in the design projects. It also covers the impact of the selected resources used in the design projects on the final solution, the individual, society and the environment, and marketing strategies.

In order to develop a clear understanding of the content of this chapter, carefully examine the 'Students learn about ...' and the 'Students learn to ...' statements relating to **Outcome 5.6.3** in the New South Wales *Design and Technology Years 7–10 Syllabus*.

## 10.1 Selecting technologies

The initial selection of a technology from a range of possibilities is the key to the successful operation of any design project – technologies are unlikely to function adequately if inappropriate choices are made at the start. Although this is understood by many, people often underestimate how difficult the choice can be. The **design brief** is intended as a guide to selecting the most **appropriate** options; this tells you what your problem is and gives you a guide to what possible solutions might be.

Below is a list of possible questions you could ask yourself when you have your design brief and you need to select your **technologies** for the project.

- Know your brief/objective and your target market. Who are you targeting your project towards? Define what technology is needed in your design project.
- Price matters, but is not everything. More expensive does not necessarily mean better. Do some research and add this information to your finance plan.
- Determine what is out there and available; narrow the field. Research your products/technologies and do a comparison. Place this information in the research section of your design portfolio.
- Core functionality: How does this technology meet your needs? Does it need to have integration with other products?
- Target market use and success? Project success? Project timelines? How will the technology be implemented?
- What technologies are needed for ongoing support? Research this and buy accordingly.

Some of the technologies that are available to you as a Design and Technology student could include:

- 3D printing – rapid prototyping
- laser printer
- computer-aided design (CAD)/computer-aided manufacturing (CAM)
- computer numerical control (CNC)/computer-integrated manufacturing (CIM)
- textiles cutters and embroidery machines
- sublimation textiles printer
- blow-forming machine, saws, drills, grinders, etc.
- green screening area
- software and hardware
- laptops, scanners, printers and tablets
- smartphones
- freeware and podcasts
- web-based technologies (e.g. wikis, blogs, Moodle)
- social learning technologies (e.g. Pinterest, Edublogs, Skype, Wikispaces)
- presentation and portfolio preparation tools (e.g. Google Docs, YouTube, TED, Prezi)
- organisation and communication online tools (e.g. Dropbox, Evernote, Google Earth, Twitter, Facebook, SlideShare, Google for Education)
- digitising tablets and digital cameras.

People, cultures and societies globally rely on technologies in a number of ways:

- information management
- communication
- knowledge creation
- transportation
- food and fibre production
- energy and water management
- construction
- manufacturing
- health and well-being.

### **design brief**

a concise statement clarifying the project task and defining the need or opportunity to be resolved after some analysis, investigation and research; it usually identifies the users, criteria for success, constraints, available resources and time frame for the project and may include possible consequences and impacts

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### **appropriate**

fitting, suitable to the context

### **technologies**

the materials, data, systems, components, tools and equipment used to create solutions for identified needs and opportunities, and the knowledge, understanding and skills used by people involved in the selection and use of these

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Figure 10.1 Choosing the right technology for your design project is important

It is important to make ethical decisions about the use of these technologies and develop solutions to ensure a sustainable future for all Australians.

### Realisation of design ideas using technologies

As with other design projects, when working on projects involving technology we need to consider a range of factors, including health and safety concerns, consumer and client needs, cultural beliefs and values, and commercial realities. Apart from creative designs, designers are also responsible for the ethics of their designs and solutions.

Changes in technology require us to critically examine how those changes might influence our ideas, projects and actions as designers. Products and services, and the use of those products and services, are a manifestation of our changing societies but also change us and our environments (natural, managed, constructed and digital) in return.

It is therefore important to be critically aware of technology processes and how they might contribute to positive social change through design. Designers must always consider what the impacts of design solutions on the world around us are.

Through technologies contexts, students have opportunities to design, produce and evaluate products, services and environments using technology processes and production **skills**. For example:

- utilising knowledge from other fields, such as history, art or science
- concentrating on specific materials, such as metal, ceramics, timber, electronics or food
- focusing on a specific type of product, service or environment, such as a wholly natural or wholly digital environment
- focusing on a single area of specialisation, such as engineering, food technology or architecture.

**skills**  
the specific techniques, strategies and processes in a learning area



Figure 10.2 Students using 3D technologies in the classroom

### Tools and equipment

Stage 5 focus areas of design for students include the following:

- fashion, accessories and jewellery
- environmental, agricultural, landscape and marine areas
- aeronautical, industrial, structural, engineering and transport areas
- architectural, interior design and furniture areas
- graphical, communication, digital media, information systems and software areas
- packaging and promotional areas
- food and medical areas.

In the Design and Technology classroom there are tools and equipment that students should

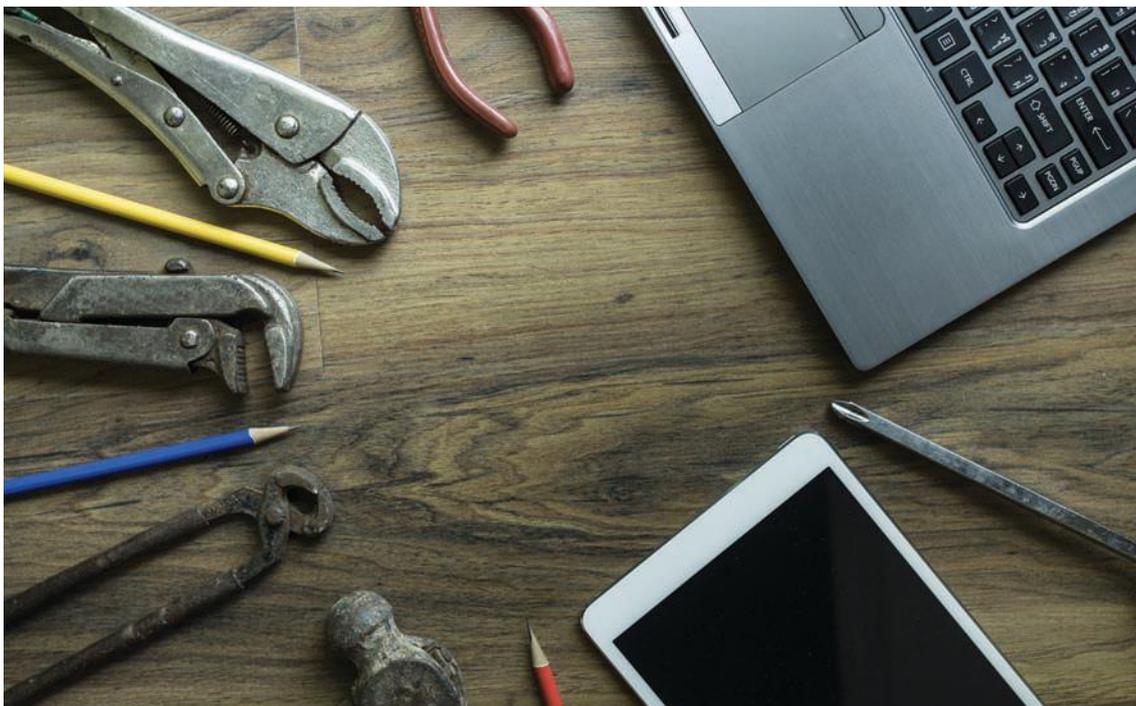


Figure 10.3 Tools and equipment used in a Design and Technology classroom



use for these focus areas. When designing and creating products, students have the responsibility to select and use appropriate and effective tools and equipment, materials, technology and data systems. The products, systems or environments they design should

be healthy, safe, socially acceptable, economic and environmentally sustainable.

### Materials

Design and Technology materials can be divided into categories as shown in Table 10.1.

Table 10.1 Various material categories

	Shape	Drill	Join	Finish	Measure	Transform	Manage
Examples	<ul style="list-style-type: none"> <li>Bandsaw</li> <li>Bench folder</li> <li>Dressmaker's scissors</li> <li>Hatchet stakes</li> <li>Jeweller's saw</li> <li>Jigsaw</li> <li>Metal lathe</li> <li>Paper patterns</li> <li>Piercing saw</li> <li>Pinking shears</li> <li>Plane</li> <li>Rasp</li> <li>Scroll saw</li> <li>Tenon saw</li> <li>Tinman's rolls</li> <li>Tinsnips</li> <li>Twisting</li> <li>Unpicker</li> <li>Wood lathe</li> </ul>	<ul style="list-style-type: none"> <li>Drill press</li> <li>Forstner bit</li> <li>Hole saw</li> <li>Metal lathe – boring</li> <li>Metal punches</li> <li>Solid punch</li> <li>Spade bit</li> <li>Twist drills</li> </ul>	<ul style="list-style-type: none"> <li>Bolting</li> <li>Buttons, studs, hooks and eyes</li> <li>Constructing frames</li> <li>Dovetail joint</li> <li>Glued joints</li> <li>Hot melt glue</li> <li>Knockdown fittings</li> <li>Machine sewing</li> <li>Mitre joints</li> <li>Nuts and bolts</li> <li>Overlockers</li> <li>Sewing and stitching</li> <li>Soldering</li> </ul>	<ul style="list-style-type: none"> <li>Appliqué</li> <li>Embroidery</li> <li>Food presentation</li> <li>Plastic coating</li> <li>Polishes</li> <li>Spray paints</li> <li>Stains</li> <li>Vegetable oil</li> <li>Water-based sealer</li> </ul>	<ul style="list-style-type: none"> <li>Checking squareness using a try square</li> <li>Constructing and marking out angles other than 90°</li> <li>Estimating weight and measuring length, width and thickness in mm</li> <li>Marking and measuring angles to suit a design brief</li> <li>Measuring tapes</li> </ul>	<ul style="list-style-type: none"> <li>Casting</li> <li>Drying</li> <li>Fabricating constructions (e.g. carcase, framed, laminated) with emphasis on accuracy and strength</li> <li>Freeze drying</li> <li>Injection moulding</li> <li>Mixing lists of ingredients (e.g. blending, folding, whisking, kneading, steaming, boiling)</li> <li>Modifying recipes</li> <li>Moulding</li> <li>Preserving</li> </ul>	<ul style="list-style-type: none"> <li>Blade sharpening</li> <li>Carrying/lifting</li> <li>Catering</li> <li>Consumer protection</li> <li>Devising equipment for using materials (e.g. jigs)</li> <li>Dietary guidelines and consumption</li> <li>Duty lists</li> <li>Health and safety issues with materials/ingredients</li> <li>Labelling</li> <li>Material budgets</li> <li>Materials/ingredients</li> </ul>

**create** putting elements together to form a coherent or functional whole; reorganising elements into a new pattern or structure through generating, planning or producing

Design and Technology produces solutions to needs and opportunities. The increasingly sophisticated knowledge and understanding developed depends on the technologies required for the solutions. The subject focuses on materials, tools and equipment, systems, technologies and social factors. Knowledge and understanding should be drawn from both contemporary and historical sources of:

- the properties and characteristics of the tools and equipment, materials and systems that are central to technologies, whether traditional, contemporary or

emerging, and factors that may restrict their use

- the combinations of the connections between tools and equipment, materials and systems that **create** solutions to problems or identify new opportunities
- the ways in which people develop and use technologies to provide solutions to meet their needs
- social factors, including economic, ethical and environmental issues that affect the relationship between technologies and people (individuals and communities, whether local, national or global) both positively and negatively.



### Design and make a metal garden outdoor sculpture

You have been asked by a landscape designer to design and construct a small garden sculpture in the theme of 'Creature Feature'. The sculpture will be a feature piece employing skeletal features and be constructed using metal processes.

#### Limitations

To satisfy the client's needs, your sculpture must observe the following limitations:

- size – must not exceed 500 mm in any direction
- display method – must be either free-standing, ground spike or hanging
- joints – must incorporate braze welding, bolting, pop riveting
- safety – completed sculpture must not have sharp edges or protruding points
- finish – must have a high-quality, corrosion-resistant paint scheme.

#### Tools and equipment needed to make a metal garden outdoor sculpture

Tools and equipment needed for this design project are:

- marking-out tools – ruler, centre punch, scribe
- hacksaw
- coping saw
- pedestal drill

- various grades of files
- drill press
- magna bender
- cold saw
- plasma cutter
- spot welder
- braze welding techniques
- computer and software to present research work
- paper and pencils to sketch ideas.

#### Materials needed to make a metal garden outdoor sculpture

Materials needed for this design project are:

- mild steel flat bar and rod
- tin plate
- miscellaneous nuts, bolts, wire, springs, etc.

#### Techniques needed to make a metal garden outdoor sculpture

Techniques needed for this design project are:

- sketching and researching
- marking out
- cutting and shaping
- joining
- finishing processes
- possibly the use of new technologies such as electroplating and powder coating of metals.



Figure 10.4 A dinosaur sculpture

1 Complete the table below for the design projects listed.

Design projects	Tools and equipment needed for this design project	Materials needed for this design project	Techniques needed for this design project
1 Design and make a car that is made out of balsa wood. It will be powered on CO <sub>2</sub> canisters. It will be tested and raced along a 50-metre track.			
2 Design and make a marketing/corporate identity kit for a new business. The kit must include a business card, flyer, 'with compliments' slip, letterhead and pamphlet that could be used for the launch of a new business.			
3 Design and make a range of children's clothing, aimed at ages five to seven. The range must include a skirt, pants or shorts and a top to be worn by a male and female child. It needs to have a chosen theme seen throughout the range.			
4 Design and produce a container for use in your home that will hold and grow herbs. There should be at least five herbs that could be produced. The container should be made from metal and timber.			



Figure 10.5 Corporate identity – an example of a design project

- 2 Analyse why it is important to select the right tools and equipment, materials and techniques for your design project.
- 3 Thinking about a design project you have completed in your senior school

years in Design and Technology, analyse the approach you took when choosing the tools and equipment, materials and techniques for the design project.



Figure 10.6 An example of materials used in a Design and Technology classroom

### Selecting and using tools and equipment

Once you have planned the manufacture of your product, system or environment, you should be ready to turn your idea into reality (also known as realisation). Hopefully you will find this the most enjoyable part of Design and Technology. If you have planned and prepared thoroughly, the realisation of your project should be straightforward. The stages of manufacture will have been identified and broken down in a detailed working schedule. This schedule could also be called an action plan. Each job, such as marking out, cutting and joining, has its own special tools. You will need to consider carefully which tools

to choose. This will lead to greater accuracy when starting to cut and join separate parts together. There may be times when you need to modify or alter your idea due to limitations and constraints placed on the project. This might be a result of the material or manufacturing processes you have available in your school. Record all the modifications you make in your portfolio.

Quality is the key issue throughout your project. In both your folio and your practical realisation, you should always aim to produce work of the highest quality. This starts with the selection of tools, equipment and materials and the initial marking-out stages.

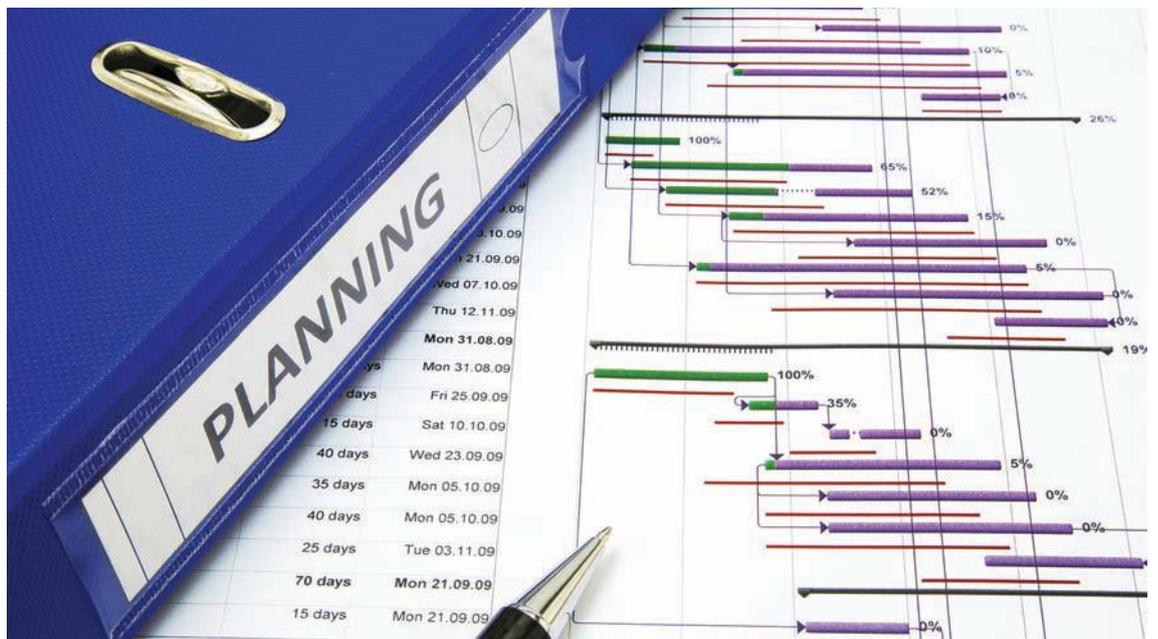


Figure 10.7 Example of a time/action Gantt chart. You would write all your tasks in the action column and assign a time to them; this will help you complete your project on time.

### Justifying the selected resources

You will be asked to justify the selection of appropriate materials, components, processes, including industrial processes and equipment, and other resources in the development of your design project. You are to present logical reasons why you have chosen the materials, the components, the processes and other resources.

- You must provide options in each category before you can justify your choice.
- Reasons (justification) must be given for your choices, and these reasons must be based on substantial research and experimentation, which should be documented in the research section of your portfolio.
- Use the headings shown in Table 10.2 so that you can complete this section correctly.

Table 10.2 Selection and justification of materials, processes and components

Selection and justification of materials (list all of the materials used in your project and for each state the options and justify your selection)		
Options	Selection	Justification of selection (based on documented research)
<b>Frame</b>		
<ul style="list-style-type: none"> <li>• Solid timber</li> <li>• Veneered MDF</li> <li>• Plywood</li> </ul>	Solid timber	<ul style="list-style-type: none"> <li>• Timber has the required strength to support the table top.</li> <li>• Timber is able to be joined using strong joints to increase the durability of the project.</li> </ul>
<b>Drawers</b>		
<ul style="list-style-type: none"> <li>• MDF</li> <li>• Plywood</li> <li>• Radiata pine</li> <li>• Hardwood</li> </ul>	Hardwood	As the drawer sides won't be seen, and to save on costs, chosen timber was not selected. Hardwood was selected, as it will last longer as the drawer is used and is cheaper than the chosen timber.

(continued)

**Selection and justification of processes (list all of the processes carried out on your project and for each state the options and justify your selection)**

Options	Selection	Justification of selection (based on documented research)
<b>Joining leg to apron</b>		
<ul style="list-style-type: none"> <li>• Dowel joint</li> <li>• Biscuit joint</li> <li>• Mortise and tenon joint</li> <li>• Loose tenon joint</li> </ul>	Mortise and tenon joint	The mortise and tenon is one of the strongest joints because of its large gluing surface and the shoulders add strength and stability to the joint.

**Selection and justification of components (list all of the components used on your project and for each state the options and justify your selection)**

Options	Selection	Justification of selection (based on documented research)
<b>Drawer runners</b>		
<ul style="list-style-type: none"> <li>• Metal slides</li> <li>• Timber slides</li> <li>• Plastic slides</li> </ul>	Metal slides	<ul style="list-style-type: none"> <li>• Strong</li> <li>• Durable – long-lasting</li> <li>• Smooth operation</li> <li>• Self-closing</li> <li>• Simple to attach</li> </ul>



Figure 10.8 Chest of drawers – a design project

**Design situation**

Elements of design from past eras are repeated and contemporised in modern designs. During the twentieth and twenty-first centuries, many products became design classics or ‘icons’ from the moment they were produced. This has often led to the product being the defining image associated with the decade it was created in and, as a result, influencing other forms of design within that period. Inspired by these antique, vintage and retro looks, products

are continually redefined and reinvented for a more contemporary marketplace. This is evident in the selection of forms, materials and technologies used from fashion to interior design. Design is often cyclical, returning full circle to a contemporary version of a historic piece.

Design icons from the late nineteenth century to the present day are often classified into the decade in which they were produced. These popular products of the period have retained a timeless quality and gained popularity over the years. These products have been deemed to be unique to the time, memorable in their shape and classic in leading an entire design movement. Such designs are viewed as works of art, despite their functional purpose. These designs were based on new ideas at the time and creative ways to develop and manufacture a product.

Design classics include:

- Coca-Cola bottle
- Eileen Gray table
- London Tube map
- Bertoia wire chair
- Anglepoise lamp
- iPhone.



Figure 10.9 The Coca-Cola bottle is a classic design.



Figure 10.10 The iPhone is a recognisable design in contemporary society.

### Design brief

Design and produce a small piece of furniture that has been inspired by a decade in design. Consider how a range of different materials and processes might be used to produce the styling and structural features required.

## ACTIVITY 10.1

### producing

actively realising (making) designed solutions using appropriate resources and means of production

It is important to select and use appropriate materials, processes and components when designing and **producing** each design project. Complete a table like the one below for the design project described above.

Selection and justification of materials		
Options	Selection	Justification of selection (based on documented research)
Selection and justification of processes/techniques		
Options	Selection	Justification of selection (based on documented research)
Selection and justification of components/tools and equipment		
Options	Selection	Justification of selection (based on documented research)

## 10.2 Selecting techniques

A technique is the way that something is done. It can be divided into two categories, these being the areas of skills that are specific or general. With specific skills, the technique would usually be associated with a particular occupation. For example, a surgeon would need a steady hand and would have learned how to identify visually what organ needs to be repaired. In the general

skills area, an example may be strategies you have employed and implemented to ensure that you complete your homework before the due submission date. The focus groups in Design and Technology consist of skills or techniques you need to master in order to complete design projects in these areas. Some skills and techniques are listed in Table 10.3.

Table 10.3 Various techniques and skills in Design and Technology

Focus area	Some of the techniques and skills you would need to select or learn if completing a design project in this area
Architectural	Researching; sketching; project management; mastering an architectural software package; libraries; fly-throughs and animations; rendering; printing
Digital media	Researching; sketching; project management; mastering software packages in digital imagery; digital video; video games; web pages and websites, including social media; data and databases; digital audio (e.g. MP3s and e-books); saving and managing files; packaging; CAD, CAM, CIM; marketing the files
Fashion	Researching; sketching; project management; sourcing and costing materials; pattern making; grading and fitting; cutting; marking and measuring; toiles and prototypes; basic construction and sewing skills (e.g. darts, seams, waistbands, collars, cuffs, facings, pockets, buttons, buttonholes, zips, plackets, hems, linings, pads, sleeves); ironing and finishing
Furniture	Researching; sketching; project management; sourcing and costing materials; cutting list; using marking-out tools; cutting; filing; sanding; finishing; upholstering; powder coating; using the 3D printer; using the laser cutter; measuring and shaping
Graphical	Researching; sketching; project management; sizing and manipulating; mastering software packages in photograph manipulation; drawings; line art; graphs; diagrams; typography; numbers; symbols; geometric designs; maps; engineering drawings; combining text, illustration and colour; the deliberate selection, creation or arrangement of typography alone (e.g. in a brochure, flyer, poster, website or book); rendering; printing



Figure 10.11 An example of a technique that a student has chosen – fashion drawing and sketching

## Realisation of design ideas using techniques

### design process

in Design and Technology, design processes are: investigating; generating; producing; collaborating and managing; evaluating

The **design process** in Design and Technology includes a realisation or making section, which involves you as a student learning skills or techniques to make your product, system or environment.

You need to be able to develop one final chosen idea that is best suited to the requirements of a brief or project. Select a final idea that:

- satisfies the requirements of the brief or project
- takes full account of target market feedback and research conducted
- meets targets/deadlines – management plan.

Consider:

- the purpose or identified need
- how choices can generate new directions
- creative and innovative combinations/applications
- traditional materials put to new uses
- budget/resource implications
- safe working practices.

You need to develop a final proposal considering, for example:

- initial sketches, 3D visualisations, a representation of what things might be like (e.g. a digitally manipulated image or drawing of your design)
- choice of materials/techniques
- using other designers' work to support informed decisions
- applying innovative and creative thinking
- evolving a personal approach/style
- how the final piece will be produced (e.g. timing, costs).

You will need to be able to present a final proposal to the target market for feedback and approval. For example:

- explanation of how meaning, purpose, thoughts and feelings might be conveyed to the audience
- sample material (e.g. maquettes, mood boards, design boards, sketchbooks, digital presentation)
- awareness of suitable materials/technology.



Figure 10.12 Sketchbooks may be part of the final proposal presented to the target market.

Take account of feedback considering:

- suitability of proposed final idea to meet the client's requirements/preferences
- permission to proceed with final outcome
- use of any target market feedback to refine final proposal
- where appropriate, how to modify/refine the final idea.

You need to be able to produce a final outcome that meets the requirements of a client brief or project. For example:

- Use materials, techniques and technologies safely.
- Monitor progress to meet targets and deadlines.
- Identify opportunities for improvements as work progresses.
- Consider practical restraints and aesthetic qualities.

You need to be aware of where the location or nature of work requires an outcome to be done to scale. The outcome could be presented as a prototype/maquette/model, showing how the work would be seen when finished (e.g. a digitally manipulated image).

You need to be able to evaluate the success of the final outcome. Consider, for example:

- how well the brief was satisfied
- target market/audience reaction
- effectiveness of the original research
- how knowledge gained could influence future work
- final product against the original intention
- conflicting demands of the brief or project
- practical constraints/suitability of materials and processes
- effectiveness of the management plan
- conflicting demands of client preferences.



Figure 10.13 Realisation of architectural blueprints to a 3D model of a house using techniques such as rendering, modelling, animating and printing

## Selecting and using a variety of appropriate techniques

Some appropriate methods, processes and techniques in Design and Technology have been discussed previously and will be examined further next.

### Sketches

Sketches include thumbnail drawings, rough and developmental sketches, technical drawings, exploded views of construction/form, and computer-aided drawing forms.



### Storyboards

Storyboards are a series of sketches or photographic evidence that visually illustrate how the design solves the design problem. Often, storyboards feature visualised actions that are framed into various stages to properly communicate how the design physically operates.

### Demonstrations

Demonstrations are the ultimate method used to **demonstrate** primarily how the design will function. Demonstrations of a design often accompany the use of sketches, technical drawings, CGI, storyboards and prototypes to effectively communicate ideas to a client, company or entity.

### Prototypes

Prototypes are miniature or scaled-down model samples, which can either be functional or non-functional. Essentially, the purpose of a prototype is to represent in 3D, and to communicate to the client, company or entity, the design and/or aesthetically related issues using the convenience of a scaled-down portable model.

### Selection of appropriate communication techniques

The selection of appropriate communication techniques ensures that the target market's requirements are met, and communicated and reinforced via the designer and target market to ensure that the objectives of the project are achieved.

An architect would select a combination of appropriate techniques, such as oral communication, sketches and CAD designs, and prototypes or scaled models of the building being designed. An auto vehicle designer would select a combination of appropriate techniques, such as attending company briefings, oral communication, communicating with engineers in writing and physical meetings, and presenting the design via sketches, CGI, prototypes and models.

The key to successful communication is the selection of techniques that the designer will use to communicate with the target market to realise the transition from an idea to finished product or intended objectives of the project.

**demonstrate**  
give a practical  
exhibition or  
explanation

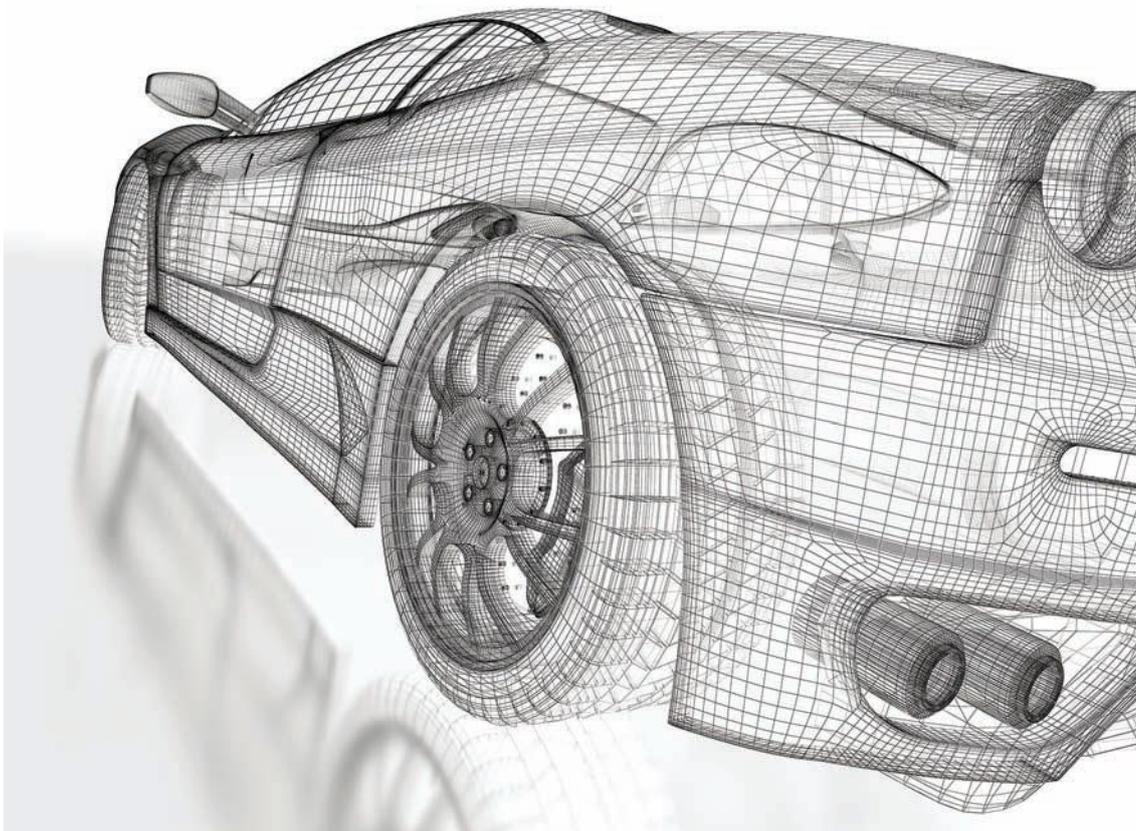


Figure 10.16 Computer-generated rendering or CGI of a car – selecting and using a rendering technique in a design project

## ACTIVITY 10.2

You have been asked to design and produce an e-book about sustainability and recycling in the household. It will be sent to households as part of a government educational campaign. This activity can be completed in groups. Put together a design brief and remember to identify the following:

- target market
- strengths, weaknesses, opportunities and threats
- possible design ideas
- factors that will influence the design.

Complete the following research:

- Look at examples of e-books and find out what the 'e' stands for.
- Create a plan that will outline how you will gather information about e-books and learn about their features.
- Record any information you discover on e-books that will be relevant to your project.
- **Investigate** the features of multimedia software packages and select the correct platform for your e-book.

### investigate

students critique, explore and investigate needs, opportunities and information

To assist you with the project, here is a list of features and key words you can use within your brief:

action button	image	slide
animation	intellectual property	slide design
background	JPEG	slide layout
bitmaps	manipulation of images	slide master
copyright	mouse-click event	TIFF
evaluation	mouse-over event	timing
file formats	narration	transition
formats	production	vector graphics
hyperlink	resolution	white space

Once you have completed your design brief, answer the following questions.

- 1 What is an e-book?
- 2 Why would this be an appropriate way to present a campaign on sustainability and recycling to households?
- 3 Identify the factors this project would need to have for it to be successful.
- 4 Explain a variety of materials that could be used when designing and producing the e-book.
- 5 Explain a variety of tools and equipment that could be used when designing and producing the e-book.
- 6 Explain a variety of techniques that could be used when designing and producing the e-book.
- 7 What makes a technique appropriate?
- 8 Identify all the ideas you would have when designing and producing your e-book if you were asked to complete this design project.



## 10.3 Evaluation and self-assessment

### Criteria for success

The criteria for success is a list that states clearly the important function and aesthetic features of your planned design. The criteria for success should be completed at the beginning of the design process and should be referred to throughout the entire process. It will be an important tool in achieving your intended design solution and for your final evaluation. Depending on your overall design, your criteria for success will include a range of things. Some areas you may consider when developing your criteria include:

- functionality
- aesthetics
- ergonomics
- safety
- cost
- target market
- durability.

Once you have established your criteria, the most effective way to display them is in a table (see Table 10.4). For each criterion you have listed, you need to justify why it is important to the success of the project, then describe how you will test or evaluate whether or not the criterion was met.

Table 10.4 An example of criteria for success for a design project

Design project: A video showing people how to recycle in their own homes		
Criteria	Justification	Method
<b>Functional criteria</b>		
It must hold the audience's attention and keep them interested for the entire duration. Should not be tedious or monotonous.	Studies show that people lose interest in videos if they are longer than three minutes. In order to engage their full attention, it should be a short film.	Show the film to groups and record their reactions while they watch.
It must create a strong impression on the viewer.	Use statistics and facts about waste and pollution.	Research statistics and facts about waste and pollution.
It must show the possibilities and potential of digital media.	Discover new ways to share video and use popular applications such as YouTube or Vine.	Test the video on different platforms to choose the most suitable one.
By the end of the video, it must show how to recycle in our own homes.	Main purpose of the video is to be informative.	Show the film to groups of people and quiz them on their recycling knowledge afterwards.
<b>Aesthetic criteria</b>		
It must include a balance of genders and people of different backgrounds.	Appeals to a broader range of people.	Inspect the video on completing.
It must have an effective set of graphics.	Helps the viewer to digest facts and statistics.	Show the film to groups of people and quiz them on their recycling knowledge afterwards.
It must include Australian products.	This will make sure the video is relatable to the audience.	Research what products Australian households use.

## Evaluating

Evaluation is one of the most important steps in the design process. It will help you determine what was done right, what areas there are for improvement and whether the overall target was achieved. In order to effectively evaluate your work, it is important to monitor your progress and keep records of all actions. By doing this, you keep abreast of whether the inputs are producing the planned outputs and whether the design is remaining true to the design brief.

When evaluating your project, it is best to always refer back to your original design brief and use your criteria for success to measure your progress. Analyse the aesthetics and test the function of the project, always referring back to your listed criteria.

Evaluations do not need to be just completed at the end; it is imperative to the success of your project that you evaluate at each stage of the design process. However, an overall evaluation should be completed at the end. Consider the following points when completing a final evaluation.

- 1 Are you happy with the overall design? What would you change?
- 2 Did the materials you chose create the outcome you intended?
- 3 Is the colour scheme suitable?
- 4 Did you complete the project within the timeline? If not, what alterations could be made to ensure timeliness?
- 5 Is your design safe?
- 6 Did the techniques you used suit your project? Did you have to alter techniques?
- 7 Does everything work? Are there any design faults?
- 8 Did you address the target market's needs?
- 9 Does the design look right?
- 10 What external feedback have you received?

Evaluation does not end with your project. In order to grow as a designer, you should also evaluate yourself. Self-assessment means looking back on your own actions, attitude and performance to gain a better understanding of

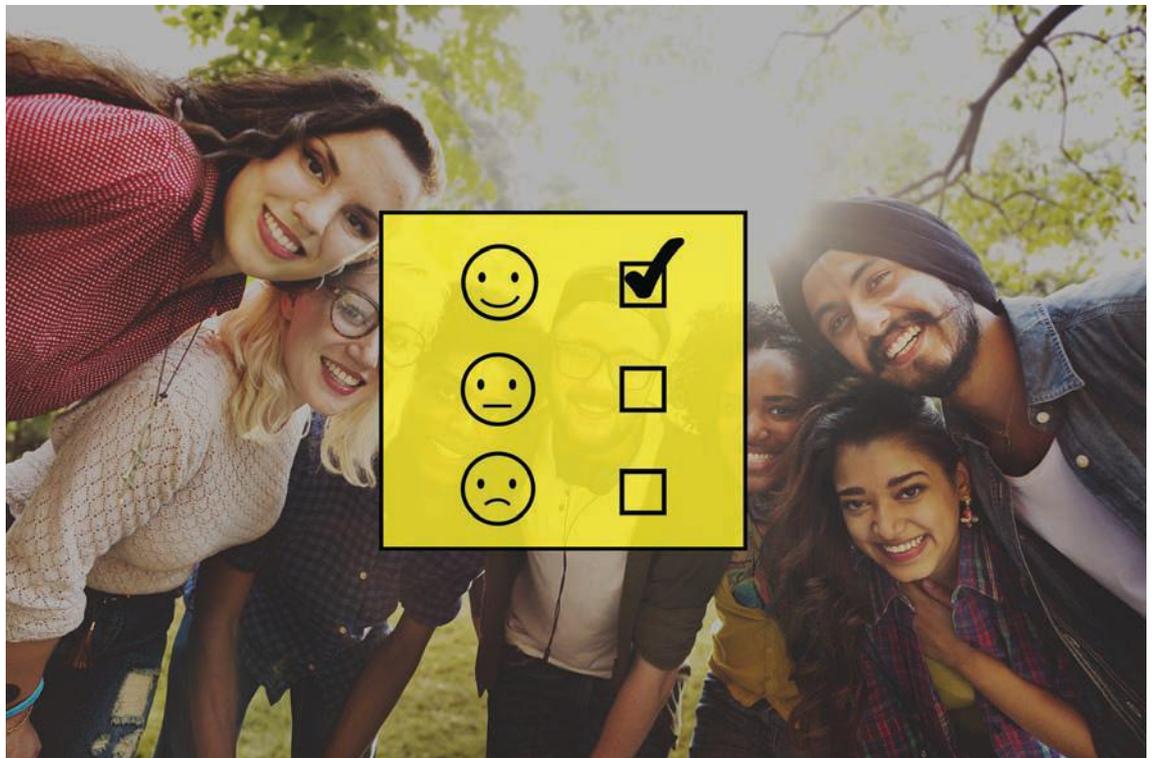


Figure 10.17 Conducting a peer evaluation

your design skills and experience as a designer. This can be a rewarding experience where you take the time to acknowledge your hard work and successes as well as identify areas you can improve, ultimately making you a better designer. Questions you may like to ask in your self-assessment include:

- 1 What did you find most challenging?
- 2 What did you find easy?
- 3 How did you handle any issues that arose?
- 4 What could you do differently next time?
- 5 How do you rate your performance?

### Evaluation techniques

There are a range of ways to evaluate your projects. The technique you use will likely depend on the overall project and what exactly you want to have clarified at the end. Some evaluation techniques include:

- At the beginning of your project, create a checklist of everything you want to achieve when you have completed

the design. Go through the checklist and check points off if they have been achieved.

- Create a questionnaire with which you can ask yourself or other people to gain external feedback. The questionnaire could include questions similar to the ones above or more specific questions.
- Conduct interviews with the people you have worked with on the project to gain their perspective and learn from their experiences. You could also interview your target market, present them with the designed solution and record their reactions.
- Extensive testing and experimenting will alert you to any design faults.

You can divide your evaluation into three sections – individual (you), society (your target market) and the environment (where the product, system or environment will be used). You can ask yourself the questions in Table 10.5.



Figure 10.18 An interview is one way to evaluate your project.

Table 10.5 Evaluation questions you can ask yourself

Individual	Society	Environment
<ul style="list-style-type: none"> <li>• How does it affect you?</li> <li>• Does it make your life easier or more valued?</li> <li>• Does it increase your quality of life?</li> <li>• Does it affect your behavioural buying?</li> <li>• Does it affect your demographics and geography?</li> <li>• Does it increase your skills and knowledge?</li> <li>• Does it substitute low cost over quality?</li> <li>• Who set the budget? Did you keep to it?</li> <li>• What was the nature of your work? What skills did you learn?</li> </ul>	<ul style="list-style-type: none"> <li>• Does it satisfy the target market's needs?</li> <li>• How has it affected society or the community?</li> <li>• How does it relate to use by society? Cost? Influences?</li> <li>• Are people better off because of it?</li> <li>• Are people happier or safer because of it?</li> <li>• Are people more aware or wealthier because of it?</li> <li>• Does it give people more leisure time or increased status?</li> <li>• How will it be used by society?</li> <li>• Do people possess greater skills, knowledge or understanding because of it?</li> <li>• Does it relate to social or moral conscience?</li> <li>• Did it address technological change?</li> <li>• Did it address ethics and privacy?</li> <li>• Did the advertising connect with the target market?</li> </ul>	<ul style="list-style-type: none"> <li>• Did you consider ecological issues and sustainability?</li> <li>• Did you consider paper supplies and pollution?</li> <li>• Did you consider non-renewable and renewable resources?</li> <li>• Did you consider environmental effects?</li> <li>• Did you consider planned/built-in obsolescence?</li> <li>• Did you consider cradle-to-grave analysis?</li> <li>• Did you conduct a life-cycle analysis?</li> <li>• Did you consider the environment in which it will be used?</li> <li>• Could it be better used in the environment for which it was designed?</li> <li>• Was there a shortage of raw materials?</li> <li>• Did it address increasing government intervention laws?</li> <li>• Did it address tropical deforestation?</li> <li>• Did it address waste/water pollution?</li> <li>• Did it address resource consumption?</li> </ul>

An example of a student self-evaluation is provided below.

### Design brief

Conduct an investigation of ways that people have adorned their bodies for different occasions, places and times. Select a culture and research the importance of body adornment. What meaning does the adornment carry for the wearer? Reflect on this and develop silver jewellery design ideas using a range of sources of inspiration.

### Example of student self-evaluation

As part of the design process of jewellery technology, it is important to evaluate not only our process, but also our product. This is imperative in determining the success of my

product, which is a South American-inspired necklace. Evaluating a design is a necessary part of the design process. This process will help me measure my skills and understanding of jewellery technology, things that could be changed, how well I work individually and how I would approach something like this again in the future. I will evaluate different aspects of the design and parts of the process that led to it. This will include the:

- purpose of my work
- aesthetics
- materials and finish
- improvements to be made.

### *Purpose of my work*

This design process, like many successful design processes, included

a design brief that I was required to analyse, evaluate and follow throughout the process. I needed to consider this during the design and development of my end product so that it was a success and followed course guidelines. The design brief specifically stated that the purpose of our work was to design, produce and evaluate a piece of adornment using a culture as inspiration. Analysing this brief as a class, we discovered that the design brief was saying that we have the choice of designing for whomever we want and that we will have to select a particular culture with notable jewellery styles and source our products from this. It also meant that we needed to consider carefully what is meaningful to us in terms of expression and adorning ourselves. We also had the opportunity to think

about what kinds of jewellery we like and the different cultures around the world that we respect and are inspired by generally. The brief also stated that we would be working with resin or silver, so therefore our work plays the role of a resin/silver jewellery piece. Our work also has the purpose of combining a number of different materials, including copper, fabric and beads, to create a unique and diverse product. The brief also stated that the product will include the elements and principles of design, which are:

- elements of design – line, colour, shape, texture (visual arts), space, form
- principles of design – unity, point, line and plane (plp), balance, hierarchy, scale, dominance, similarity and contrast, movement rhythm/pattern.

## ACTIVITY 10.3

Answer the questions below based on the following design brief: Design and construct a model boat that is made out of wood.

- 1 Make a list of research that would need to be completed before starting the project.
- 2 Compile a list of criteria that would be considered for the success of the wooden boat. The criteria list should start with 'My boat must ...'
- 3 In a table like the one below, list the materials, tools, equipment and techniques that would be used.

Materials	Tools and equipment	Techniques
•	•	•
•	•	•
•	•	•
•	•	•
•	•	•
•	•	•
•	•	•
•	•	•
•	•	•
•	•	•
•	•	•

- 4 Complete an ongoing evaluation of the progress you have made so far in the design and construction of the wooden boat. What are the possible things that could go wrong?

## Peer assessment and self-assessment

Peer assessment is a form of assessment that involves students making decisions on assessment about other students' work. When a student makes decisions on assessment about their own work, it is called self-assessment. These forms of assessment both involve self-development, and are therefore considered forms of reflective practice. They can involve assessing student work in the form of presentations, exams, essays, reports and design projects. Peer assessment and self-assessment can form a major part of **formative assessment**. They can also contribute to **summative assessment** and help provide the following outcomes:

- **intrinsic motivation** – a desire to learn
- **extrinsic motivation** – a need to learn
- learning by doing (through practice and being allowed to make 'mistakes')
- learning via feedback from others.

Peer assessment and self-assessment are important because:

- they increase the likelihood that students will engage with the work
- students develop their interpersonal skills and learn to receive and give feedback in a positive, constructive way, and learn from that feedback
- research has shown that, when given a clear marking scheme, the marks given by students on their own and others' work are usually fair
- students can gain an insight into, and an appreciation of, their own and others' learning styles
- they allow students to be more aware of how their work is marked in general, thereby leading to possible improvements in their work.

## Justifying and documenting decisions

Justification and documentation of decisions are achieved in the 'design rationale', a document recording the reasoning used in the design process, which should be included in your portfolio. It should carefully

list all decisions and the reasons for them. Its main aim is to support the designer in communicating arguments for decisions in the design process. The design rationale should contain for each decision:

- the other alternatives considered and their advantages and disadvantages
- the arguments behind the decision and the reasons and justification for it, including how the decision achieves the aims of the product.

Nothing backs up design decisions like data. Often someone else has already done something similar in principle. Find a case where it worked and document it in the ongoing evaluations or at the end. It is also important to validate your decisions with experimentation and testing.

Design decisions, especially something like colour, have a subjective and emotional side to them. Consult your teacher, your target market and peers in the decision-making process to help with the decision. Even with all their opinions and their views, the key is to move the focus from 'feelings' to a more objective, functional aspect of design.

Design is essentially problem solving. If you can prove that your solution is optimal, and if this is tested, you clearly have an advantage. In essence, you are not just showing the end product, but the context and the reasoning behind the decision.

Backing up your decisions and justifications with research data is also good practice. In the example of colour, there are studies



Figure 10.19 Conducting research on colour for a design project

### formative assessment

a range of formal and informal assessment procedures, including diagnostic testing, conducted by teachers during the learning process in order to modify teaching and learning activities to improve student attainment

### summative assessment

the assessment of participants where the focus is on the outcome of a program; contrasts with formative assessment, which summarises the participant's development at a particular time

### intrinsic motivation

when a person is motivated by internal factors (e.g. job or task satisfaction)

### extrinsic motivation

when a person is motivated by external factors (e.g. money)

done in psychology and consumer behaviour. Talk about how and why a specific colour will help differentiate your design from those

of competitors, and how it will generate a particular experience for the end-user when using your product, system or environment.

## ACTIVITY 10.4

Choose one of the reflective activities described in Table 10.6 and complete it for the last design project you worked on.

Table 10.6 Reflective activities

Reflective activity	What is involved in this reflective activity?
Journal of learning	'Journal' here is used in the sense of a diary or log in which students record each task or key stage of the project, noting how it went. They should reflect on and write down not just what went well and was achieved, but what did not go well and what improvements they could make. Mistakes should also be noted so that they can be learned from. Learning journals are also useful for group activities and processes, to record what each member did as well as the individual's own achievements.
Checklists	Checklists should be created as preparation before each task. The items should then be ticked off to record what has been achieved during the task. The information gained can be used to write up the learning journal and any reports or documents required in the portfolio. As well as being essential to organise individual and group work, checklists, like the learning journals, help students see how important reflection is to learning.
Peer review	Students should review their own performance in individual tasks and others' performance in group tasks, listing strengths, weaknesses and areas for improvement. Peer review is another reflective skill that helps students learn principles of effective working and behaviour in teamwork.
Class discussion	Class discussion can be used to communicate reflections and thoughts on your own and the group's performance, especially how improvements can be made.
Responses to teacher feedback and peer review	In their responses students should say what they have done in response to feedback from the teacher and in the peer review, saying in particular what they have done or will do to improve their own performance as an individual or in groups.
Report (reflective paper)	<p>A report on individual and group processes helps students learn through reflection on such questions as, in group work:</p> <ul style="list-style-type: none"> <li>• how they got to know each other's ideas and strengths at the outset</li> <li>• how they allocated tasks and organised their time</li> <li>• how they developed the group presentation</li> </ul> <p>and, in individual work:</p> <ul style="list-style-type: none"> <li>• what they did well or what were their strengths</li> <li>• what they did not do well or what were their weaknesses</li> <li>• what they learned from peer reviews or other groups' presentations</li> <li>• what they can do to improve performance next time.</li> </ul>

## 10.4 The impact of resource selection

### Final solution

There are factors that you need to constantly check to ensure that you stay on track, including resources, your management plans (time, action, resources and finance), and your practical project and its progress. As is often said, 'sometimes the inspiration gets lost in the perspiration'. It can be easy to lose sight of the problem that you initially set out to solve if you are not careful, and you could find yourself getting 'lost' in all of the work that you are putting in.

Questions to ask yourself include:

- Will my solution solve the problem?
- Is it of high quality?
- Have I chosen the most appropriate resources, processes, finishes, materials, tools and techniques?
- Have I done enough research to know that I have chosen the right resources?
- Has someone else done this before? Have I researched all existing design solutions?
- Is the solution reliable, safe and functional?
- Is the solution aesthetically appropriate to the design project?
- Is the solution cost and time efficient?
- Am I making the most of the latest or emerging technologies available to me?
- What are the factors contributing to the success of this design? How can I maximise the use of these factors?
- Are there any factors detrimental to this design? How can I overcome these difficulties?
- Have I considered at every point the impact on the individual, society and the environment?
- Is this a clever and ingenious idea? How can I make it more clever and ingenious?

All of the above points need to be addressed; but most importantly address the impact of the final product, system or environment.

### Individual, society and environment

The digitalisation that has occurred over the past 15 years has fundamentally changed society and individual lives. Almost everything and everyone is connected. This has changed not only our behaviour, but also the foundations of virtually every organisation. This trend is about people connecting with each other, with products and services and with organisations. It impacts on resource selection when completing design projects and designers when choosing what materials, tools and techniques they will include in the designs.

The mantra 'less is more' is not relevant in an era of abundance. There has been a gradual growth in the amount of 'information' and 'things' we accumulate as a result of the Industrial Revolution, mass production and the internet. However, research has demonstrated that the ideal number of choices is actually lower than we might assume. Filter mechanisms are required in this world of abundance where consumers are overwhelmed.

When considering how our society has changed with technology, innovations and emerging technologies, an era of abundance and digitalisation, we can also look at our designing at school and examine some of the choices we have made in our design projects. Consider these questions:

- Does your design fill a specific need or want from within society? Does it make completing a task more time-efficient? Is it a redesign of an existing product from within the market? How will it be in direct competition within the marketplace?
- A significant contributing factor towards the development of a design is social and moral values associated with the design in the society. Does your design cause offence to a particular niche in society? As Australia is a multicultural



Figure 10.20 Gaming is popular and addictive for very clear reasons.

society, this needs to be considered seriously. Also, colours and symbols may hold vastly different symbolic meanings in different cultures.

- Is your design ethically responsible? For example, this may refer to child labour and exploitation of workers on low wages in developing countries for cheap manufacturing of products.
- How did you go about selecting your resources? What research did you do? How do you justify your choices?
- Finances and your finance plan: Is the product, system or environment only available to a select range of people? Are you redesigning an existing product to be more cost-effective so as to be made available to a wider market?

Looking at the environment, this not only refers to the natural environment but also the physical or virtual environment the design is intended for. An example of this is hospital beds. For easy mobility they have wheels on the legs, and handles to assist in the speedy transportation of patients. The beds are made out of steel for durability. The designer looked at the area they would be designing the beds for.

Environment also refers to responsible environmental design, and moral values associated with the design. Does your design incorporate damaging materials? Is it recyclable? Will it contribute to landfill once the design life-cycle has ended? Is the design sustainable and appropriate? Are any hazardous chemicals used, such as harmful colourants that will ultimately end up being washed into the natural water cycles and the environment and be potentially damaging? In relation to textiles, this may refer to the use of natural fibres, such as cotton, as opposed to synthetic fabrics that cannot be recycled as effectively. Does the design incorporate animal products such as leather or fur? This may be offensive to animal activists and be seen as morally and ethically wrong as well as environmentally damaging.

Does the product, system or environment restrict its end use? For example, is it too large for the environment it is designed for? Does the design consist of suitable materials for its environment? For example, for a child's play tent, the materials used would have to be durable, and the coating on the tent must not be harmful to children.



Figure 10.21 It is important to be aware of responsible environmental design.

## ACTIVITY 10.5

- 1 Explain the socio-cultural implications of a new technology.
- 2 Identify the drivers behind recent technology trends.
- 3 Why is choosing the most appropriate resource important?
- 4 How can play and game principles be used to motivate students or engage the target market?
- 5 How do different target groups (e.g. men, women, generations) differ in play?



Figure 10.22 A children's tent that has been designed for its environment and end use





## Chapter summary

- The initial selection of a technology from a range of possibilities is the key to the successful operation of any design project – technologies are unlikely to function adequately if inappropriate choices are made at the start.
- You are required to justify the selection of appropriate materials, components, processes, including industrial processes and equipment, and other resources in the development of your design project. You are to present logical reasons why you have chosen the materials, the components, the processes and other resources.
- Once you have planned the manufacturing process of your product, system or environment, you should be ready to turn your idea into reality (also known as realisation).
- Some appropriate techniques typical of most of the focus areas in Design and Technology and the design projects that can be selected and used are sketches, technical drawings, CAD, CAM, computer-generated rendering or CGI, storyboard generation, demonstrations, prototypes and selection of appropriate communication techniques.
- Criteria for success can be divided into two categories: functional and aesthetic. The criteria should outline all the necessary principles of your design, list the justification as to why it is important and explain the method to be used when evaluating.
- Evaluation is an ongoing process throughout the realisation of your design. It will help you determine what was done right, what areas there are for improvement and whether the overall target was achieved.
- Your evaluation method will vary depending on your project. There are a range of evaluation techniques you can use, including:
  - using a checklist
  - conducting interviews to collect feedback
  - testing and experimenting.
- Peer assessment is a form of assessment that involves students making decisions on assessment about other students' work. When a student makes decisions on assessment about their own work, it is called self-assessment. These forms of assessment both involve self-development, and are therefore considered forms of reflective practice. They can involve assessing student work in the form of presentations, exams, essays, reports and design projects.
- A design rationale is a document recording the reasoning used in the design process that lists all decisions and the reasons for them. Its main aim is to support the designer in communicating arguments for decisions in the design process.
- Digitalisation has created a society where everyone is connected. The impacts can be observed from an individual level to an organisational level. Digitalisation impacts resource selection when completing design projects and designers when choosing what materials, tools and techniques they will include in the designs.

## Define key terminology

- |   |             |    |                 |
|---|-------------|----|-----------------|
| 1 | Appropriate | 10 | Peer assessment |
| 2 | Criteria    | 11 | Producing       |
| 3 | Designing   | 12 | Reflect         |
| 4 | Document    | 13 | Requirements    |
| 5 | Equipment   | 14 | Self-assessment |
| 6 | Evaluation  | 15 | Success         |
| 7 | Justify     | 16 | Techniques      |
| 8 | Materials   | 17 | Tools           |
| 9 | Multimedia  |    |                 |

## Chapter summary tasks

- 1 Explain why it is important to select the most appropriate materials, tools and processes or techniques for your design project.
- 2 List some techniques, processes or skills you have completed since being in the senior school.
- 3 Why is justifying your final selection of resources important?
- 4 List the steps followed for a realisation of a design project you have completed in Stage 5.
- 5 Analyse the process of evaluation within design and producing design projects.
- 6 If you were asked to design a salt and pepper shaker, what would be the criteria for success? Use 'It must ...' statements.
- 7 Explain the term 'evaluation techniques'. How could they be used in the Design and Technology classroom?
- 8 Looking at the impacts on individuals, society and the environment, analyse the social changes that have happened since the launch of the mobile phone.
- 9 Explain the impacts of resource selection in designing and producing.
- 10 Define the terms 'development' and 'management' in the context of selecting and using a range of technologies in the development and management of design solutions. Discuss how you would undertake these two processes when completing design projects.

## Extension task

In a table like the one below, identify the positive and negative impacts that the elements listed have on the individual, society and the environment. You will need to do some research on the elements' design.

Element		Positive impact	Negative impact
Apple iPad	Individual		
	Society		
	Environment		
Plasma TV	Individual		
	Society		
	Environment		
IVF	Individual		
	Society		
	Environment		
Cross City Tunnel, Sydney	Individual		
	Society		
	Environment		
Marc Newson's Lockheed Lounge	Individual		
	Society		
	Environment		
Philippe Starck's citrus squeezer	Individual		
	Society		
	Environment		
Alex Perry's eyeglasses	Individual		
	Society		
	Environment		

# Glossary

**aesthetics** a branch of philosophy dealing with the nature of art, beauty and taste. It is more scientifically defined as the study of sensory-emotional values, sometimes called judgements of sentiment and taste. Aesthetic judgement is concerned with the visual impact or appeal of a product or environment and is influenced by social, emotional and demographic factors.

**annotations** notes made on a drawing to describe particular points of interest

**anthropometric data** measurements relating to the study of the human body and its movement

**appropriate** fitting, suitable to the context

**appropriate technology** encompassing technological choice and application that is small scale

**Arduino** micro-controller based kit used to build devices and interactive objects

**biodegradable** able to break down naturally

**biomimicry** an inspiration of functions found in nature for use and adaptation in the design of a product, service or environment or to solve human problems. For example, velcro fastening was inspired by small hooks on the end of burr needles. Termite mounds that maintain a constant temperature through air vents inspired architects to design cooling for buildings.

**CGI (computer-generated imagery)** the application of computer graphics to create or contribute to images in art, printed media, video games, films, television programs, commercials, videos and simulators

**cloud computing** distributing computing over a network where storage of files, processing of data and/or access to software occurs automatically on interconnected server computers to which the user's device is connected. Typically, people use the term to refer to accessing files and software over the internet. For example, photo files may be stored in the 'cloud' from a smartphone to be accessed later from a different location; where they are actually stored can be anywhere in the world on a server computer used by the cloudservice.

**cognitive organiser** a visual diagram of interacting ideas, thoughts or elements

**collaboration** working together with others on a project for a common goal

**computer-aided design (CAD)** software used by designers, architects and engineers to create lines, shapes and planes that can be combined, moved, rotated, adjusted and rendered. Measurements and calculations can be included. Computer-aided design can be used to create two- and three-dimensional models and drawings such as floor plans, interior and garden designs, and to represent objects and structures.

**concept sketches** the first ideas produced when using a design process to develop a solution to a design brief

**concise** brief and clear

**configuration** the arrangement of elements in a particular form, figure or combination

**consultation** a meeting with the purpose of reaching an agreement

**consumer pull** interest in a specific product created by a particular target market

**contemporary** belonging to or occurring in the present

**control** a standard of comparison used to check results

**create** putting elements together to form a coherent or functional whole; reorganising elements into a new pattern or structure through generating, planning or producing

**criteria** standards by which a design project may be judged or decided

**criteria for success** a descriptive list of essential features against which success can be measured. The compilation of criteria involves literacy skills to select and use appropriate terminology.

**demonstrate** give a practical exhibition or explanation

**design** an idea, sketch or plan to show the look and function of an object, system or environment

**design brief** a concise statement clarifying the project task and defining the need or opportunity to be resolved after some analysis, investigation and research; it usually identifies the users, criteria for success, constraints, available resources and time frame for the project and may include possible consequences and impacts

**design portfolio** a document used to record the design process used when producing a solution to a design brief

**design process** in Design and Technology, design processes are: investigating; generating; producing; collaborating and managing; evaluating

**designed solution** in Design and Technology, a product, service or environment that has been created for a specific purpose or intention as a result of design thinking, design processes and production processes

**discrepancy** an instance of inconsistency or difference

**discrimination** the unfair treatment of a person or group

**durability** an ability of an object or system to withstand or resist wear, pressure or damage over a long period of time and remain in good condition. For example, long-lasting outdoor furniture made of suitable materials and construction methods to withstand rain, heat and light from the sun; a sports uniform made of suitable materials to withstand frequent washing, and wear and tear, from the movement of the sportsperson.

**emerging technologies** new technologies that are currently developing or will be developed and that will substantially alter the business and social environment

**entrepreneur** a person who sets up and manages new commercial enterprises to make a profit

**environment** one of the outputs of technology processes and/or a place or space in which technology processes operate. An environment may be natural, managed, constructed or digital.

**ergonomics** understanding of the activity of humans within systems or in an environment to maximise the well-being of humans and their productive use of those systems or environments

**ethics** moral principles that govern a person's behaviour or the conducting of an activity

**evaluate** measuring performance against established criteria. Estimating nature, quality, ability, extent or significance to make a judgement determining a value.

**extrinsic motivation** when a person is motivated by external factors (e.g. money)

**formative assessment** a range of formal and informal assessment procedures, including diagnostic testing, conducted by teachers during the learning process in order to modify teaching and learning activities to improve student attainment

**Gantt chart** a detailed grid that displays the tasks to be undertaken and time allocated, and maps these on a specified timeline

**globalisation** the process of economic, financial and cultural interaction and integration around the world

**hardware** the physical machines and infrastructure related to digital technology

**hazard** something that is potentially very dangerous

**human capital** the skills and knowledge embodied in the ability to perform labour to produce economic value or a final design and product

**humanities** the study of human culture

**improvisation** spontaneously acting on or creating something

**incentive** a payment or concession to motivate or encourage action

**innovation** something new or different introduced

**interdependent** relying on each other

**interface** a program that enables the user to operate a computer

**intrinsic motivation** when a person is motivated by internal factors (e.g. job or task satisfaction)

**invention** something made through original ideas

**investigate** students critique, explore and investigate needs, opportunities and information

**LED** light-emitting diode creating high-powered light using a small amount of electricity

**legislation** a law passed by an elected government

**limitation** a restriction or rule that prevents progress

**market niche** a specialty area to address the needs and wants of consumers

**market push** marketing techniques employed by companies to promote their products

**materials** substance from which a thing is or can be made. Natural (e.g. animals, food, fibre, timber, mineral) and fabricated (e.g. metal alloys, plastics, textiles, composites) materials. Materials are used to create products or environments and their structure can be manipulated by applying knowledge of their origins, structure, characteristics, properties and uses.

**microtechnology** miniaturisation of computer circuits and microchips

**multiculturalism** a diverse culture made up of various races, religions or other groups

**multifunctional** having more than one use or fulfilling multiple needs

**need** a requirement by an individual or a group

**Newton's laws** the study of forces relating to motion – action and reaction

**peer review** an evaluation of your work by others in the same field

**personal protective equipment (PPE)** equipment used or worn by a person to minimise risk to the person's health or safety; for example, goggles, ear muffs, face shield, hard hat, apron, gloves

**pictogram** a simple picture used to describe something

**primary research** research conducted first hand

**principle** an accepted or professed rule of action or conduct

**process** actions or steps taken in order to achieve an end result

**producing** actively realising (making) designed solutions using appropriate resources and means of production

**project** a set of activities undertaken by students to address specified content, involving understanding the nature of a problem, situation or need; creating, designing and producing a solution to the project task; and documenting the process. Project work has a benefit, purpose and use; a user or audience, which can provide feedback on the success of the solution; limitations to work within; and a real-world technologies context influenced by social, ethical and environmental issues. Criteria for success are used to judge a project's success.

**project management** a responsibility for planning, organising, controlling resources, monitoring timelines and activities, and completing a project to achieve a goal that meets identified criteria for judging success

**prototype** a trial product or model built to test an idea or process to inform further design development.

A prototype can be developed in the fields of service, design, electronics or software programming. Its purpose is to see if and how well the design works and it is tested by users and systems analysts. It can be used to provide specifications for a real, working product or system rather than a virtual or theoretical one. *Prototype* is derived from Greek terms that, when translated, mean 'primitive form', 'first' and 'impression'.

**rendering** drawing that shows a relative relationship of elements or a form of objects using texture, colour, light, shade and tone (lightness or darkness of a colour). Rendered drawings are used, for example, in architecture to show what a building will look like or to show the form and shape of the body of a proposed car design. Rendering can be done by hand, or using computer software such as computer-aided drawing.

**responsible design** in which social, environmental, moral or ethical considerations inform the design

**risk** a situation that may expose someone to danger, harm or loss

**secondary research** information gathered and presented by other people

**self-sufficient** able to provide for one's own needs without outside help

**skills** the specific techniques, strategies and processes in a learning area

**social media** websites and applications that allow users to create and share content through social networks

**society** a body of individuals living as members of a community

**software** programs and operating information required for the control of computers and technology

**stakeholder** a person or group with an invested interest in the outcome of a design process

**summative assessment** the assessment of participants where the focus is on the outcome of a program; contrasts with formative assessment, which summarises the participant's development at a particular time

**target market** a group in society with specific needs

**technologies** the materials, data, systems, components, tools and equipment used to create solutions for identified needs and opportunities, and the knowledge, understanding and skills used by people involved in the selection and use of these

**technology** the use of scientific knowledge for practical purposes

**tooling** the process of acquiring the manufacturing components and machines needed for production

**trends** current colours, textures and designs in fashion

**virtual technologies** technologies used in the creation of a virtual (rather than actual) version of something

**wi-fi** computer code to allow devices to connect to the internet wirelessly

Some glossary terms © Australian Curriculum, Assessment and Reporting Authority (ACARA)

# Index

- action planning 72, 118, 133
- advertising 126
- aesthetic criteria 35, 181
- aesthetic techniques 66
- aesthetics 4, 64
- Age Discrimination Act 2004* (Cth) 160
- agriculture, and design 5
- alignment, as design principle 7
- annotations 101
- anthropometric data 8
- Anti-Discrimination Act 1977* (NSW) 160
- anti-discrimination legislation 160
- appropriate communication techniques 121–2
- appropriate techniques, selecting and using 177–9
- appropriate technology
  - choices and design decisions 67
  - definition 78
  - and design issues 86–7
  - determining appropriateness 32, 86
  - and ethical and responsible design 78–9
  - impact 89–90
  - questions to consider 67
- architectural techniques 175
- architecture 9
- Arduino technology 12
- Australian Human Rights Commission Act 1986* (Cth) 160
- Australian Standards 109
- automated teller machines (ATMs) 89
  
- Babbage, Charles 84
- balance, as design principle 7, 8
- bamboo 12
- Bessant, John 80
- bike helmets, criteria for success 35–6
- biodegradability 11
- biomass smokeless stove 82
- biomimicry 103, 112
- BMW car design 68–71
- brainstorm lists 73
- brainstorming 3, 15, 100
- branding 31
- budgets 135
- built environments, careers in 51
  
- CafePay 136
- calculators 84
- Canobolas Rural Technology High School 158–9
- car design 68–71
- careers in design and manufacturing 51–2, 55–6
- Chandler, Len 87
- charts 118
- Chegwyn, Emma 144–7
- Child's Chair 74
- clock design 191–2
- cloud computing 106
- cognitive organisers 15, 73
- collaboration 73, 104–5
- collaborative methods 16–17
- colour, as design element 6
- commercial settings, designing in 45
- communication techniques 116–22, 179
- communication technology 90
- competition 31
- computer-aided design (CAD) 12, 81, 102
- computer-generated imagery (CGI) 178
- computer-generated rendering 178
- computers 84
- concept boards 73
- concept sketches 15, 100–1, 117
- concrete cups 144–7
- configuration 64
- constraints analysis 73
- consultation 157
- consumer pull 27
- contemporary considerations 64
- contrast, as design principle 7
- costs, estimating 31, 135
- creative ideas, techniques for generating 99–106
- creativity 73
- criteria for success 31, 35–6, 181
- cultural diversity 44
- culture, and design 44–5
  
- data, bias, accuracy and privacy of 87
- demonstrations 179
- design
  - definition 2
  - interdisciplinary nature 10–11
  - interrelationship with technology 12
- design briefs 118, 131–2, 165
  
- design classics 173–4
- design concepts 2–3
- design considerations 31–2, 64
- design disciplines 9–10
- design elements 6–7
- design icons 173–4
- design ideas
  - areas of investigation 138
  - documentation of realisation 142–3
  - realisation using techniques 176–7
  - realisation using technologies 166–74
- design issues, and appropriate technology 86–90
- design portfolios 116, 118
- design principles
  - applying in new situations and contexts 7–8, 17–18
  - key principles 7
- design process, key stages 3, 176
- design situation 173
- design solutions
  - developing 15–19
  - predicting future directions 93–4
- design thinking 2
- designed solutions 100
- designers
  - women and men as 51
  - work of past and current designers 52–4
- designing, as part of design process 3
- digital communication techniques 119–20
- digital content 120
- digital media 175
- direct discrimination 160
- direct marketing 126
- direction, as design element 6
- Disability Discrimination Act 1992* (Cth) 160
- discrepancies 133
- discrimination 160
- distribution of product 125
- documentation of design ideas 142–3
- domain-general skills 66
- domain-specific skills 66
- domestic settings, design approaches 45
- Dominguez, Sally 18
- durability 28, 71

- Dyson design process 123–4
- Dyson, James 123
  
- Eco Splash System (ESS) 112–13
- egalitarianism 59
- elements of design 6–7, 8
- emerging technologies 83–4, 84–5
- emotional design 26
- end-users
  - aspirations and context 64
  - identifying needs of 29–30
  - requirements of 23–4
- enterprising activity 111–13
- entrepreneurs 111–13
- environment
  - impact of design 49–50
  - impact of production 86
  - impact of resource selection 189
  - impact of technologies 90
  - nature of 10
- environmental responsibility 86
- environmental sustainability 68
- equal employment opportunity (EEO)
  - principles 160–1
- equipment, selection 166–7, 171
- Equipment Safety in Schools (ESIS)
  - document 158–9
- ergonomics 66
- ethics
  - and issues relating to responsible design 86–9
  - and responsibilities 78–9
  - and selection of processes, materials and techniques 67
- evaluation
  - criteria for success 31, 35–6, 181
  - justifying and documenting decisions 186–7
  - as part of design process 3, 118
  - peer assessment 186
  - self-assessment 182–3, 186
  - self-evaluation 184–5
- evaluation process 182
- evaluation techniques 183
- evolution 3
- experimentation 37–40, 138, 140
- exploration 3, 73
- extrinsic motivation 186
  
- Facebook, advantages and disadvantages 49–50
- fashion design 9–10
- fashion design techniques 175
- finance considerations 72
- finance plans 31, 135
- fitness clothes 92
  
- FLOAT House 13–14
- form 64
- formative assessment 186
- '4 Ps' of marketing 125
- function 63–4
- functional criteria 35, 181
- functional techniques 66
- furniture design techniques 175
- future, preferred futures 91–2
- future considerations 64
- future directions, predicting 93
  
- Gantt charts 118
- gesture recognition 83
- globalisation 59
- graphic design 9
- graphic design techniques 175
- graphical presentation techniques 117–18
- graphs 118
- green design 5
- Green, Frank 136
- green technology 90
- Greeno, Lola 46–7
- Greentom strollers 143
  
- hardware 12
- hazards
  - identifying and assessing 151–2
  - minimising or eliminating 152–3
- health-monitoring systems 92
- heart surgery 88
- Himalaya Help 105–6
- hip implants 88
- historical considerations 64
- HOG rainwater tank 40–1
- holistic approach 63–5
- home settings, designing in 45
- honesty 86
- hoodia 79
- human capital 66
- humanities 10
  
- iBGStar 17
- idea-generation, techniques 99–106
- ideas development 118
- immigration 46
- improvisation 46
- incentives 31
- Indigenous people 45–6
- indirect discrimination 160
- individuals
  - impact of design 49–50
  - impact of resource selection 188
  - impact of technologies 89
- industrial design 9, 45
- industrial legislation 67
- industrial settings 45
- Infinity laptops 27–8
- information and communications, careers in 51–2
- innovation
  - by designers 26
  - examples 81–4
  - nature of 80
  - types 80–1
- innovative ideas, techniques for generating 99–106
- intellectual property 87
- interdependence, of humans and nature environment 2
- interdisciplinarity of design 10–11
- interior design 9
- internet 84
- interviews 24–5, 121
- intrinsic motivation 186
- inventions 2
- investigation areas 137–8
- isometric projections 117
  
- jewellery design 10, 52–3
- job safety analysis (JSA) 154
  
- LED lights 12
- legislation
  - anti-discrimination 160
  - industrial and workplace 67, 155–7
- life-cycle analysis 31
- Lily Camera 18–19
- limitations 132
- line, as design element 6, 8
- Lockheed Lounge 48
- logos 118
- long-term consequences
  - evaluation 34
  - failure to consider 90
- Lovelace, Ada 84
  
- market niche 10
- market push 27
- market research 22
- market research techniques 24–5
- marketing strategies 125–6
- materials
  - areas of investigation 138
  - categories 168
  - definition 6
  - identifying 140
  - justification of selection 137, 172–3
  - managing 137–43
  - selecting 71, 168
  - understanding 100

- medical industry, role of design 4
- medical procedures, and 3D printing 87–8
- medical technology 91
- metal garden outdoor sculpture 169–71
- microtechnology 12
- mind maps 73, 100
- Mobelife 88
- modelling 16, 102, 118, 123
- multiculturalism 44, 46, 58
  
- needs, identifying 22–5, 132
- needs and opportunity analysis 73
- Nest high chair 17–18
- Newton, Marc 48
- Newton's laws 10
- NSW Mental Health Line 127–8
  
- oblique projection 118
- observation, as research method 25, 103–4, 121
- online advertising 126
- opportunities
  - identifying 26–30, 132
  - for new and better solutions 26–7
- oral communication techniques 119
- orthogonal projections 117
- Oxford Vaccine Group 105–6
  
- paradigm innovation 80–1
- Pascal, Blaise 84
- past technologies, impact 84
- Patents Act 1990* (Cth) 67
- peer assessment 186
- peer review 108
- perceptual user interfaces (PUIs) 83
- personal protective equipment (PPE) 145, 153, 155
- personal values 67
- perspective projection 118
- pictograms 155
- Placid Pools 112–13
- Playsam 75
- plus, minus and interesting (PMI) charts 100
- pneumonia vaccine 105–6
- pollution 90
- position innovation 80
- preferred futures 91–5
- presentation techniques 116–20
- price 125
- primary research 24, 107
- principles 78
- principles of design 7–8
- print advertising 126
  
- problem-solving techniques 73
- process innovation 80
- product design, careers in 51
- product innovation 80
- product marketing 125
- product specification sheets 142–3
- production plans 133–4
- project-management strategies 131–2
- projects 15, 24
- promotion 125
- prototypes 3, 179
- prototyping 3, 16
- proximity, as design principle 7
- purpose of design 4–5, 31
  
- qualitative research 107
- quality 64
- quantitative research 107
  
- Racial Discrimination Act 1975* (Cth) 160
- radio advertising 126
- rapid prototyping 81
- recliner armchairs, elements and principles of design 8
- refining design ideas 32
- regulatory criteria 35
- rendering 16, 178
- repetition, as design principle 7
- research and exploration
  - accessing information and data 107–8
  - appropriate materials, processes and production methods 108–9
  - collaboration 73
  - data collection methods 107
  - of existing designs 15
  - identifying and summarising information 109–10
  - of material, tools and techniques 138
  - of target audience 121
  - types of research 107
- research results 118
- resources
  - choices and availability 71–2
  - impact of selection 188–92
  - justifying selection of 172–3
  - requirements 32
  - resource list 137
- respiratory diseases 90
- responsible design 78–9, 86–7
- risk assessment 151–2
- risk management 151–3
- risk-control hierarchy 152–3
  
- safe operating procedures (SOPs) 154, 155
- Safe Work Australia 156
- safe work method statements (SWMSs) 154
- safe work practices 154
- safe working environment 154–5
- safety 66–7, 86
- safety signage 155
- SafeWork NSW 156, 157
- San people 79
- secondary research 24, 107
- self-assessment 182–3, 186
- set design 10
- settings, impact on design 44–6
- Sex Discrimination Act 1984* (Cth) 160
- shape, as design element 6, 8
- shell-stringing 46–7
- short-term consequences, evaluation 34
- size, as design element 7, 8
- sketches 177–8
- skills 66, 166
- SmartCup 136
- social change 44–5
- social class 58–9
- social conscience 59
- social issues 58
- social media
  - and communication 119–20
  - impact of Facebook 49–50
  - for marketing 126
- social sustainability 67–8
- society
  - impact of design 49–50
  - impact of resource selection 188–9
  - impact of technologies 90
- software 9
- space, as design principle 7, 8
- specifications for designs 118–19
- Spelta, Amanda 113
- Spelta, Joe 112
- spider silk 81
- sports stadiums, elements and principles of design 8
- stakeholders
  - identifying needs of 29–30
  - requirements of 23–4
- storyboards 179
- summative assessment 186
- surveys 24, 121
- sustainable design 191
- SWOT analysis 73
- symbols 118

- target audience
  - communicating with 121–2
  - understanding of 121
- target markets 22, 31, 100
- techniques
  - appropriate techniques 177–9
  - areas of investigation 138
  - for generating creative and innovative ideas 99–106
  - identifying 140
  - justification of use 137
  - managing 137–43
  - realisation of design ideas using 176–7
  - role of 66
  - selecting 175–80, 177–9
  - types 66
  - see also* communication techniques
- technological change 59
- technological convergence 84–5
- technologies
  - realisation of design ideas using 166–74
  - reliance upon 165
  - selecting 165–74
- technology
  - appropriate technology 32, 67, 78–9, 86–90
  - definition 2
  - impact 84–5, 89–90
  - interrelationship with design 12
- telemarketing 126
- television advertising 126
- testing 37–9, 140
- textile design 10
- texture 8
  - as design element 6
- 3D printing 81, 87–8
- time management 72
- time/action plans 72, 118, 133
- timing 26, 31
- titanium bone implants 87
- tooling 9
- tools
  - areas of investigation 138
  - identifying 140
  - justification of use 137
  - managing 137–43
  - selection 71, 167–8, 171
- Trade Practices Act 1974* (Cth) 67
- traditional crafts 46–7
- trends 22, 58–9, 65
- understanding, and design process 3
- van Hooydonk, Adrian 68, 71
- Vasicek, Jai 56
- Vedel, Kristian Solmer 74
- virtual technologies 71
- visual presentation techniques 117–18
- Water Garden 33–4
- WaterWear backpack 95
- wearable fitness devices 83–4
- wearable technology 92
- women, as designers 51
- Work Health and Safety Act 2011* (NSW) 86, 155–7
- workplace health and safety
  - legislation 155–7
- workplace legislation 67
- written communication 118–19