Product Design and Technology

Victorian Certificate of Education **Study Design**

Victorian Curriculum and Assessment Authority
2011

COVER ARTWORK WAS SELECTED FROM THE TOP ARTS EXHIBITION. COPYRIGHT REMAINS THE PROPERTY OF THE ARTIST.

Latoya BARTON
The sunset (detail)
from a series of twenty-four
9.0 x 9.0 cm each, oil on board

Liana RASCHILLA
Teapot from the *Crazy Alice* set
19.0 x 22.0 x 22.0 cm
earthenware, clear glaze. lustres

Kate WOOLLEY
Sarah (detail)
76.0 x 101.5 cm, oil on canvas

Christian HART
Within without (detail)
digital film, 6 minutes

Merryn ALLEN
Japanese illusions (detail)
centre back: 74.0 cm, waist (flat): 42.0 cm
polyester cotton

James ATKINS
Light cascades (detail)
three works, 32.0 x 32.0 x 5.0 cm each
glass, flourescent light, metal

Lucy McNAMARA
Precariously (detail)
156.0 x 61.0 x 61.0 cm
painted wood, oil paint, egg shells, glue, stainless steel wire

Tarkan ERTURK
Visage (detail)
201.0 x 170.0 cm
synthetic polymer paint, on cotton duck

Nigel BROWN
Untitled physics (detail)
90.0 x 440.0 x 70.0 cm
composition board, steel, loudspeakers, CD player, amplifier, glass

Chris ELLIS
Tranquility (detail)
35.0 x 22.5 cm
gelatin silver photograph

Kristian LUCAS
Me, myself, I and you (detail)
56.0 x 102.0 cm
oil on canvas

Ping (Irene VINCENT)
Boxes (detail)
colour photograph

Tim JOINER
14 seconds (detail)
digital film, 1.30 minutes

Accredited by the Victorian Registration and Qualifications Authority
Level 6, 35 Spring Street, Melbourne, Victoria 3000

Developed and published by the Victorian Curriculum and Assessment Authority
41 St Andrews Place, East Melbourne, Victoria 3002

This completely revised and accredited edition published 2011.

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Cover designed by Chris Waldron of BrandHouse
Desktop published by Julie Coleman

Product Design and Technology

ISBN 978-1-921702-55-6

Contents

IMPORTANT INFORMATION

Accreditation period

Units 1–4: 2012–2017

The accreditation period commences on 1 January 2012.

Other sources of information

The *VCAA Bulletin VCE, VCAL and VET* is the only official source of changes to regulations and accredited studies. The Bulletin also regularly includes advice on VCE studies. It is the responsibility of each VCE teacher to refer to each issue of the Bulletin. The Bulletin is available as an e-newsletter via free subscription on the Victorian Curriculum and Assessment Authority's website at: www.vcaa.vic.edu.au

To assist teachers in assessing School-assessed Coursework in Units 3 and 4, the Victorian Curriculum and Assessment Authority publishes online an assessment handbook that includes advice on the assessment tasks and performance descriptors for assessment.

The companion document to the assessment handbook 'Administrative Procedures for Assessment in VCE Studies' is available on the Victorian Curriculum and Assessment Authority's website at: www.vcaa.vic.edu.au/Pages/vce/generaladvice/index.aspx

The current *VCE and VCAL Administrative Handbook* contains essential information on assessment processes and other procedures.

VCE providers

Throughout this study design the term 'school' is intended to include both schools and other VCE providers.

Photocopying

VCE schools only may photocopy parts of this study design for use by teachers.

Introduction

SCOPE OF STUDY

Product design is part of people's responses to changing needs to improve quality of life by designing and creating artifacts. Product design is enhanced through knowledge of social, technological, economic, historic, ethical, legal, environmental and cultural factors. These factors affect the aesthetics, form and function of products developed in the past and those yet to be developed. Central to VCE Product Design and Technology is the Product design process, which provides a structure for students to develop effective design practice. The design process involves identification of a real need that is then articulated in a design brief. The need is investigated and informed by research to aid the development of solutions that take the form of physical, three-dimensional functional products. Development of these solutions requires the application of technology and a variety of cognitive and physical skills, including creative design thinking, drawing and computer-aided design, testing processes and materials, planning, construction, fabrication and evaluation.

In VCE Product Design and Technology students assume the role of a designer-maker. In adopting this role, they acquire and apply knowledge of factors that influence design. Students address the design factors relevant to their design situation.

The knowledge and use of resources is integral to product design. These resources include a range of materials, and the tools, equipment and machines needed to transform these materials in a safe manner into useful products. Increasingly, the importance of environmental sustainability is having an impact on product design and development. More sustainable approaches are therefore at the forefront throughout the product lifecycle.

RATIONALE

Designers play an important part in our daily lives. They determine the form and function of the products we use. They transform ideas into drawings and plans for the creation and manufacture of useful products that fulfil human needs and wants. In recent history the use of resources to create an ever-increasing array of products has given designers an increased responsibility to think sustainably.

Students develop an understanding of the consequences of product design choices. They develop the necessary skills to critically analyse existing products and to develop their own creative solutions.

VCE Product Design and Technology can provide a pathway to a range of related fields such as industrial, product, interior and exhibition design, engineering, and fashion, furniture, jewellery, textile and ceramic design at both professional and vocational levels. Moreover, VCE Product Design and

Technology can inform sustainable behaviours and develop technical skills to present multiple solutions to everyday life situations. It contributes to creating confident and unique problem solvers and project managers well equipped to deal with the multi-disciplinary nature of modern workplaces.

AIMS

This study enables students to:

- understand design practice and product development and how these occur in a variety of contexts and environments
- generate and communicate multiple creative ideas, concepts and product design options using a range of techniques to develop viable solutions to problems
- explore and determine characteristics and properties of materials that make them suitable for use
- examine methods of sourcing, processing, production and assembly of materials and their social, economic, ethical, legal and environmental implications
- apply appropriate, efficient and safe methods of working with materials, tools, equipment and machines using risk assessment
- apply project management techniques of time and sequence, and choose appropriate processes
- analyse and evaluate the appropriateness of production activities and product design
- understand the requirement for ethical, social, environmental, economic and legal considerations involved in designing for the needs of the broader community.

STRUCTURE

The study is made up of four units:

Unit 1: Product re-design and sustainability

Unit 2: Collaborative design

Unit 3: Applying the product design process

Unit 4: Product development and evaluation

Each unit deals with specific content contained in areas of study and is designed to enable students to achieve a set of outcomes for that unit. Each outcome is described in terms of key knowledge and key skills.

A glossary defining terms used across Units 1 to 4 in the *VCE Product Design and Technology Study Design* is included on pages 44–48 under 'Advice for teachers'.

Cross study specifications applicable to Units 1 to 4 are included on pages 12–15.

ENTRY

There are no prerequisites for entry to Units 1, 2 and 3. Students must undertake Unit 3 prior to undertaking Unit 4. Units 1 to 4 are designed to a standard equivalent to the final two years of secondary education. All VCE studies are benchmarked against comparable national and international curriculum.

DURATION

Each unit involves at least 50 hours of scheduled classroom instruction.

CHANGES TO THE STUDY DESIGN

During its period of accreditation minor changes to the study will be announced in the *VCAA Bulletin VCE, VCAL and VET*. The *VCAA Bulletin VCE, VCAL and VET* is the only source of changes to regulations and accredited studies. It is the responsibility of each VCE teacher to monitor changes or advice about VCE studies published in the *VCAA Bulletin VCE, VCAL and VET*.

MONITORING FOR QUALITY

As part of ongoing monitoring and quality assurance, the Victorian Curriculum and Assessment Authority will periodically undertake an audit of VCE Product Design and Technology to ensure the study is being taught and assessed as accredited. The details of the audit procedures and requirements are published annually in the *VCE and VCAL Administrative Handbook*. Schools will be notified if they are required to submit material to be audited.

SAFETY AND WELLBEING

This study may involve the handling of potentially hazardous substances and the use of potentially hazardous equipment. It is the responsibility of the school to ensure that duty of care is exercised in relation to the health and safety of all students undertaking the study. Teachers should refer to the Hazards guidance material within Health, Safety and WorkSafe on the DEECD Governance webpage: <www.education.vic.gov.au/school/principals/governance/Pages/technology.aspx>.

For additional information about risk assessment refer to the WorkSafe website: <www.worksafe.vic.gov.au>.

Teachers with students working in the wood and metal materials areas must be competent in the use of machinery associated with use of these materials, for example through completion of the Course in Safe Use of Machinery for Technology Teaching (Woodwork and Metalwork) (21820VIC).

Details about appropriate equipment for use in this study are included in the Advice to teachers on page 43.

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

In designing courses for this study teachers should incorporate information and communications technology (ICT) where appropriate and applicable to the teaching and learning activities.

EMPLOYABILITY SKILLS

This study offers a number of opportunities for students to develop employability skills. The 'Advice for teachers' section provides specific examples of how students can develop employability skills during learning activities and assessment tasks.

LEGISLATIVE COMPLIANCE

When collecting and using information, the provisions of privacy and copyright legislation, such as the Victorian *Information Privacy Act 2000* and *Health Records Act 2001*, and the federal *Privacy Act 1988* and *Copyright Act 1968,* must be met.

Assessment and reporting

SATISFACTORY COMPLETION

The award of satisfactory completion for a unit is based on a decision that the student has demonstrated achievement of the set of outcomes specified for the unit. This decision will be based on the teacher's assessment of the student's performance on assessment tasks designated for the unit. Designated assessment tasks are provided in the details for each unit. The Victorian Curriculum and Assessment Authority publishes online an assessment handbook that includes advice on the assessment tasks and performance descriptors for assessment for Units 3 and 4.

Teachers must develop courses that provide opportunities for students to demonstrate achievement of outcomes. Examples of learning activities are provided in the 'Advice for teachers' section.

Schools will report a result for each unit to the Victorian Curriculum and Assessment Authority as S (Satisfactory) or N (Not Satisfactory).

Completion of a unit will be reported on the Statement of Results issued by the Victorian Curriculum and Assessment Authority as S (Satisfactory) or N (Not Satisfactory). Schools may report additional information on levels of achievement.

AUTHENTICATION

Work related to the outcomes of each unit will be accepted only if the teacher can attest that, to the best of their knowledge, all unacknowledged work is the student's own. Teachers need to refer to the current *VCE and VCAL Administrative Handbook* for authentication procedures.

LEVELS OF ACHIEVEMENT

Units 1 and 2

Procedures for the assessment of levels of achievement in Units 1 and 2 are a matter for school decision. Assessment of levels of achievement for these units will not be reported to the Victorian Curriculum and Assessment Authority. Schools may choose to report levels of achievement using grades, descriptive statements or other indicators.

Units 3 and 4

The Victorian Curriculum and Assessment Authority will supervise the assessment of all students undertaking Units 3 and 4.

In VCE Product Design and Technology students' level of achievement will be determined by School-assessed Coursework, a School-assessed Task and an end-of-year examination. The Victorian Curriculum and Assessment Authority will report students' level of performance on each assessment component as a grade from A+ to E or UG (ungraded). To receive a study score, students must achieve two or more graded assessments and receive S for both Units 3 and 4. The study score is reported on a scale of 0–50; it is a measure of how well the student performed in relation to all others who took the study. Teachers should refer to the current *VCE and VCAL Administrative Handbook* for details on graded assessment and calculation of the study score. Percentage contributions to the study score in VCE Product Design and Technology are as follows:

- Unit 3 School-assessed Coursework: 12 per cent
- Unit 4 School-assessed Coursework: 8 per cent
- School-assessed Task: 50 per cent
- End-of-year examination: 30 per cent.

Details of the assessment program are described in the sections on Units 3 and 4 in this study design.

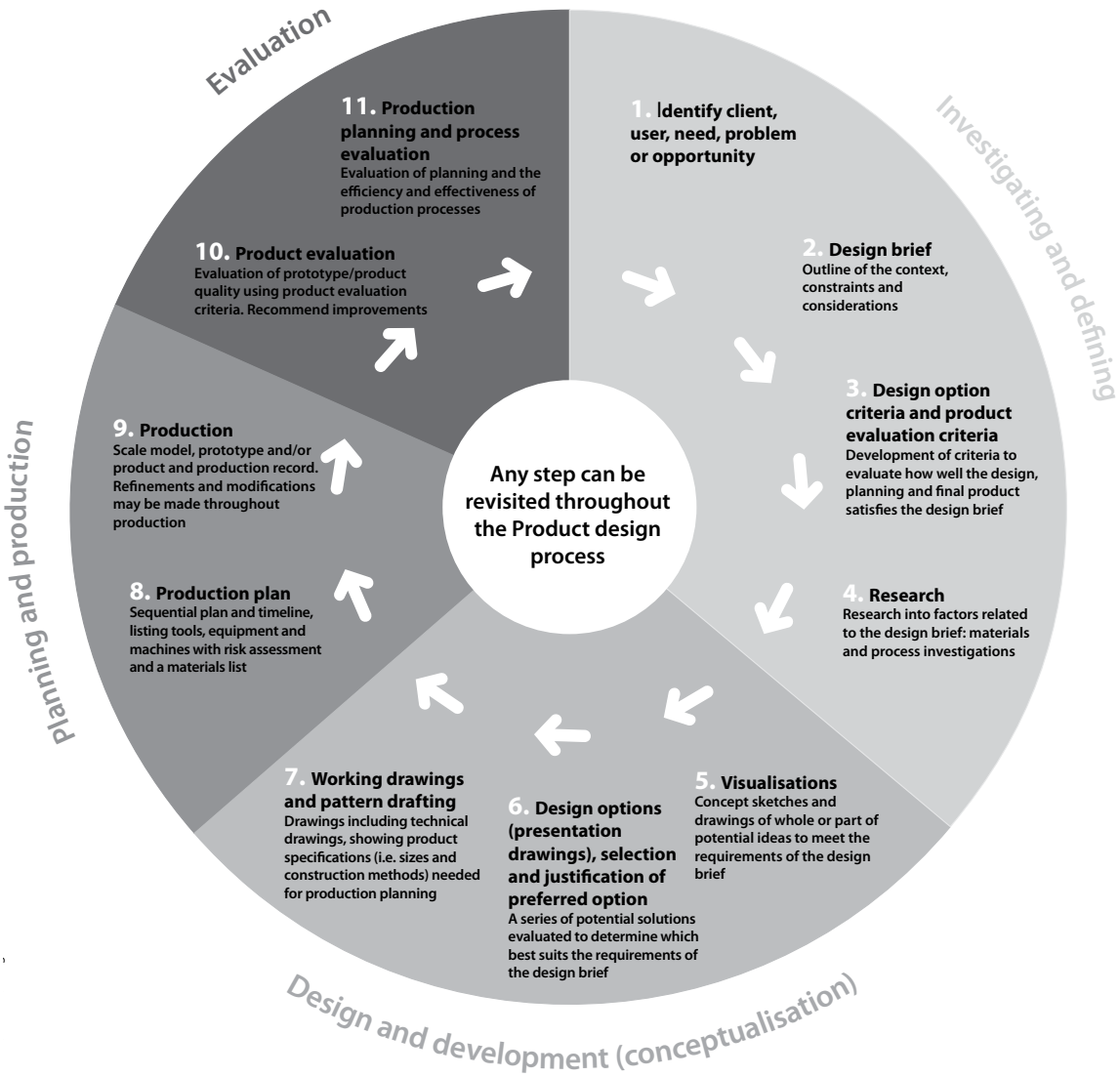
Cross study specifications

Integral to VCE Product Design and Technology are three cross study specifications applicable to Units 1 to 4. These specifications comprise: the Product design process; the Product design factors; and the materials categories. Specific details of these specifications follow. References are made to the cross study specifications throughout the VCE Product Design and Technology Study Design.

THE PRODUCT DESIGN PROCESS

For the purposes of this study the Product design process represents the four stages: Investigating and defining; Design and development (conceptualisation); Planning and production; and Evaluation. It also outlines steps that can be followed in the design and development of a product in this study. It is important to note that the Product design process is non-linear and that previous stages can be revisited if necessary. The process can be adapted and customised to suit a specific project. Depending on the situation, some steps may require more emphasis or feedback. Re-visiting steps facilitates an interface between thinking and doing to enable further visualisation of ideas, formulation and enactment of procedures. The diagram opposite outlines the four stages and the steps within these stages.

The Product Design Process: Stages and Steps



PRODUCT DESIGN FACTORS

The following Product design factors and parameters are referred to throughout Units 1 to 4 and are integral to framing product design. These factors include a range of aspects, or parameters, that influence the design of a product. Some will be included in a design brief and may also be used in product analysis.

In the table below, the factors have been placed into broad categories. However, parameters may overlap or be interconnected depending on the individual situation.

Product design factors	Parameters
Purpose, function, and context	Includes the reason or need for a product, in the context and environment of its use. This includes its operation, performance, reliability and quality. The primary and secondary functions and features that support its use are considered.
Human-centred design (human needs and wants)	Human problems or needs identified to improve wellbeing and quality of life. Cultural and religious considerations, age, economic status, emotional and sensory appeal, universal design, social and physical needs, fashion and trends are considered in response to these needs. Safety, accessibility, comfort, ergonomics and anthropometric data may also need consideration.
Innovation and creativity	Innovation requires a creative approach to develop new or improved solutions to unsolved problems or opportunities. This involves invention, improvement, modification, incremental progress, experimentation and pushing the boundaries. Opportunities are identified from research and development, user feedback, new ideas/knowledge, new materials and emerging technologies.
Visual, tactile and aesthetic (design principles and elements)	These factors relate to the product's form, appearance and feel. The design principles of balance, emphasis, repetition, movement/rhythm, pattern, proportion, symmetry, space and surface qualities are used to combine and arrange the design elements. The design elements include point, line, shape, form, texture, tone, colour, transparency, translucency and opacity. Natural forms, patterns and structures along with geometry and mathematics can also be employed to create aesthetic appeal.
Sustainability (social, economic and environmental systems perspectives)	Sustainability involves the connection and interaction between social, economic and environmental systems. Underpinning aspects include: Life Cycle Analysis and Life Cycle Thinking, emotional attachment, carbon footprints, embodied energy and water use, distribution (product miles) and use of renewable energy and resources.
Economics – time and cost	Costing a product takes into account materials, labour and use of plant (equipment and machinery) but must give value to the end-user. Time management and material availability are critical issues to consider.
Legal responsibilities	The legal aspects of product design are: intellectual property (IP) particularly Patents and Design Registration; Australian and International (ISO) standards, regulations and legislation (including OH&S). Products must be produced safely and be safe for the user.
Materials – characteristics and properties	Materials appropriate to this study are listed on page 15. Materials are selected for use based on their properties (their performance and behaviour both chemically and physically under certain conditions) and characteristics (visible features). These properties and characteristics include strength, durability, thermal resistance, hardness, density, rigidity, flexibility, corrosiveness and compatibility with other materials.
Technologies – tools, processes, and manufacturing methods	Conversion techniques (changing raw materials into useable forms) and production processes are reliant on and affected by available tools, equipment, machines, and expertise. Suitable and accurate methods are selected to perform the following: marking/setting out, cutting/shaping/forming, joining/assembling/constructing, decorating/embellishing/finishing.

MATERIALS CATEGORIES

In VCE Product Design and Technology, students design and make three-dimensional functional products using a range of construction materials. Category 1 materials are those more commonly used in VCE Product Design and Technology. In Units 1 and 2, students incorporate one or more materials from Category 1 or 2 in their product design. In Units 3 and 4, students use materials predominantly from Category 1, but may incorporate Category 2 materials in their product design, used in conjunction with Category 1 materials. Materials may also be selected from Category 3 and used in conjunction with Category 1 or 2 materials as appropriate. Category 3 materials are used to fasten, decorate, protect and finish Category 1 and 2 materials.

Students may base their products on one of the following design specialisation areas, but are not necessarily restricted to these areas.

Note: The product should not include significant mechanical/electrical and control systems components. It should not be a food, agricultural, horticultural (plant or animal) or information technology product. The purpose/function of the product should not be solely to visually communicate, or be purely decorative or aesthetic (for example, a wall hanging) or an artwork (for example, a sculpture).

Category 1		**Examples of design specialisation areas**
Wood/timber	Hardwoods Softwoods Manufactured/composite boards	Indoor and outdoor home and workplace furniture and furnishing Ironware Steel fabrication for indoor, outdoor and recreational use Gold and silver smithing (e.g. jewellery, flat ware and hollow ware) Garment/Accessories Soft furnishing Homewares such as bathroom, laundry and kitchenware Musical instruments Lighting (low voltage) Sporting equipment Toys
Metal	Ferrous metals Non-ferrous metals Alloys Coated metals	
Textiles/yarns/fibres/fabrics	Natural Blended Synthetic	
Polymers (plastics)	Thermoplastic polymers Thermosetting polymers Composites	
Category 2		
Ceramics	Stoneware Porcelain Bone china Terracotta Raku Cement	
Glass	Soda lime Lead glass (crystal) Float / laminated / toughened Borosilicate	
Category 3		
Chemical fasteners (e.g. adhesives) Dyes/paints Surface treatments/protective coatings Finishes (oil based, water based, organic)		

Unit 1: Product re-design and sustainability

This unit focuses on the analysis, modification and improvement of a product design with consideration of the materials used and issues of sustainability. Finite resources and the proliferation of waste require sustainable product design thinking. Many products in use today have been redesigned to suit the changing needs and demands of users but with little consideration of their sustainability.

Knowledge of material use and suitability for particular products is essential in product design. Additionally, knowledge of the source, origin and processing of materials is central to sustainable practices. Students consider the use of materials from a sustainable viewpoint. Sustainable practices claimed to be used by designers are examined.

Area of Study 1 provides an introduction and structured approach towards the Product design process and Product design factors. Students learn about intellectual property (IP), its implications related to product design and the importance of acknowledging the IP rights of the original designer.

In Area of Study 2, students produce a re-designed product safely using tools, equipment, machines and materials, compare it with the original design and evaluate it against the needs and requirements outlined in their design brief. If appropriate, a prototype made of less expensive materials can be presented; however, the specific materials intended for the final product would need to be indicated. A prototype is expected to be of full scale and considered to be the final design of a product before production of multiples.

AREA OF STUDY 1

Product re-design for improvement

In this area of study students are introduced to the Product design process, IP and the Product design factors, with an emphasis on materials and sustainability. Students consider case studies of designers who claim to have incorporated sustainable practices.

Students examine how an existing product currently fulfils the need of a user. They consider how the product could be improved. Students write a design brief for a product's modification and improvement by altering at least three points of the original design, ensuring the primary purpose/function of the original product remains. One of the alterations should aim to improve the product's sustainability.

Students develop evaluation criteria for design options, the completed product, and to judge the efficiency and effectiveness of design and production activities.

They also examine, test and trial suitability of materials selected from the materials categories list on page 15. They gain an understanding of the characteristics and properties of materials that make them suitable and safe for specific products. They also examine sustainability of materials and their use in products in relation to the environmental, economic and social impacts associated with their origin/source, manufacture, use and disposal.

Prior to construction of the re-designed product, students develop visualisations (concept sketches and drawings), design options (presentation drawings) and working drawings of their preferred option. Referencing the working drawing, they compile a sequenced production plan, with risk assessments, a timeline and a list of materials.

Students examine issues related to IP protection and acknowledge any design ideas that have been appropriated.

Outcome 1

On completion of this unit the student should be able to re-design a product using suitable materials with the intention of improving aspects of the product's aesthetics, functionality or quality, including consideration of sustainability.

To achieve this outcome the student will draw on key knowledge and key skills outlined in Area of Study 1.

Key knowledge

- methods of analysing a product that is an existing solution to a problem or need for identified user/s
- approaches used by different designers to incorporate sustainability practices in product design
- impacts of unsustainable products and resource use on environmental, social and economic systems
- systems, models and strategies used to assess the sustainability of a material and/or product
- the Product design process and its application to re-design and production of a product based on an existing product design
- the purpose, components and structure of a design brief, including the context or situation, and constraints and considerations
- methods of incorporating relevant Product design factors in a design brief
- methods of developing, and reasons for using, evaluation criteria for: design options; design, planning and production; and the finished product
- creative and critical design thinking methods and techniques
- the principle of IP and the importance of acknowledging the IP rights of the original designer of the product
- the role of annotation and appropriateness of different drawing techniques in the design and development stage of the Product design process, including:
  - visualisations (concept sketches and drawings)
  - presentation drawings for design options
  - working drawings and pattern drafting
  - computer-aided design (CAD)
- methods of generating, analysing and evaluating ideas for the re-design of an existing product
- origins, sources, and classification of at least two materials with consideration of their sustainability
- appropriate tests, trials, comparisons and skill practice to determine suitable production processes, and characteristics and properties, of at least two materials to suit specified purposes

- the role and content of production plans, including:
  - an expected sequence of production steps and timeline
  - a materials list
  - risk assessment for safe, efficient and accurate production of a product.

Key skills

- examine case studies of designers that are claimed to address sustainability practices and identify these practices
- analyse an existing product to be re-designed that has solved a design need or problem with reference to the relevant Product design factors
- use the appropriate systems and models to assess the sustainability of the product
- use the investigating and defining, and design and development stages of the Product design process incorporating relevant Product design factors to develop a solution for a re-designed product
- write a design brief for the modification and improvement of a product design
- describe the principle of IP in Australia and appropriately acknowledge the IP of others
- develop and present annotated drawings of the re-design of the product showing improvements
- develop a production plan with reference to working drawings.

AREA OF STUDY 2

Producing and evaluating a re-designed product

This area of study focuses on the implementation of the design and planning completed in Outcome 1. Referring to their working drawings and production plans, students safely apply a range of techniques and processes to make the re-designed product or prototype. Prototypes should be full scale and of pre-production quality, but may be constructed of alternative materials to those to be used in the final product.

Students develop practical skills and implement their risk management for the use of tools, equipment, machines, and materials. They record and reflect on their progress.

Students are introduced to the methods used to critically analyse and evaluate re-designed products. They use previously developed evaluation criteria to compare the features of their re-designed (completed) product or prototype with the original design. They judge the success of their design improvements and the changed sustainability status. For a prototype, the evaluation should include an explanation of what material and finishes would be used for the final product and why these have been selected.

Students use their knowledge of the characteristics and properties of materials and refer to their record of progress to complete the evaluation of their production work.

Outcome 2

On completion of this unit the student should be able to use and evaluate materials, tools, equipment and processes to make a re-designed product or prototype, and compare the finished product or prototype with the original design.

To achieve this outcome the student will draw on key knowledge and key skills outlined in Area of Study 2.

Key knowledge

- risk management for safe, accurate and efficient application of production processes, using materials, tools, equipment and machines
- processes applicable to selected materials
- selection of tools, equipment and machines for particular purposes
- digital and manual techniques to manage and record production processes and progress
- methods of evaluating the re-designed product or prototype, including:
  - matching of the prototype or product to the requirements of the design brief constraints and considerations
  - responding to predetermined evaluation criteria
  - comparing with the original design
  - suggesting further improvements to the prototype or product
  - reference to the intended improved sustainability
- methods of evaluating the efficient and effective use of materials, tools, equipment, machines and techniques in design and production activities, including:
  - accuracy and clarity of production plans and working drawings
  - suitability and accuracy of processes
  - effective use of time and resources
  - suggestions for further improvement.

Key skills

- apply risk management in the production of the re-designed product or prototype
- use appropriate materials, tools, equipment, machines and production processes to safely and accurately make a re-designed product or prototype
- record progress and adjustments to the production plans and timeline
- evaluate the product or prototype and suggest improvements
- evaluate the effectiveness of designing and planning for the re-designed product or prototype
- evaluate the efficiency of design, planning and production processes for the re-designed product or prototype.

ASSESSMENT

The award of satisfactory completion for a unit is based on a decision that the student has demonstrated achievement of the set of outcomes specified for the unit. This decision will be based on the teacher's assessment of the student's overall performance on assessment tasks designated for the unit.

The key knowledge and key skills listed for each outcome should be used as a guide to course design and the development of learning activities. The key knowledge and key skills do not constitute a checklist and such an approach is not necessary or desirable for determining the achievement of outcomes. The elements of key knowledge and key skills should not be assessed separately.

Assessment tasks must be a part of the regular teaching and learning program and must not unduly add to the workload associated with that program. They must be completed mainly in class and within a limited timeframe. Teachers should select a variety of assessment tasks for their assessment program to reflect the key knowledge and key skills being assessed and to provide for different learning styles.

For this unit students are required to demonstrate achievement of two outcomes. As a set these outcomes encompass both areas of study.

Demonstration of achievement of Outcomes 1 and 2 must be based on the student's performance on a selection of assessment tasks. Where teachers allow students to choose between tasks they must ensure that the tasks they set are of comparable scope and demand.

Assessment tasks for this unit are selected from the following:

- design folio that contains a design brief, evaluation criteria, research, visualisations and design options, working drawings, production plan, and evaluation report
- prototype or product and records of production and modifications
- multimedia presentation supported by speaker's notes
- short written report that includes materials testing or trialling activities, industry visits, technical reports
- case study analysis
- oral report supported by notes and/or visual materials.

Unit 2: Collaborative design

In this unit students work in teams to design and develop an item in a product range or contribute to the design, planning and production of a group product. They focus on factors including: human needs and wants; function, purpose and context for product design; aesthetics; materials and sustainability; and the impact of these factors on a design solution.

Teamwork encourages communication between students and mirrors professional design practice where designers often work within a multi-disciplinary team to develop solutions to design problems. Students also examine the use of ICT to facilitate teams that work collaboratively but are spread across the globe.

In this unit students are able to gain inspiration from an historical and/or a cultural design movement or style and its defining factors such as ideological or technological change, philosophy or aesthetics.

In Area of Study 1, students work both individually and as members of a small design team to address a problem, need or opportunity and consider the associated human-centred design factors. They design a product within a range, based on a theme, or a component of a group product. They research and refer to a chosen style or movement. In Area of Study 2 the product produced individually or collectively is evaluated.

AREA OF STUDY 1

Designing within a team

In this area of study students apply the Product design process (page 12) collaboratively and individually. Each student works in a design team to generate a group design brief from a scenario based around a theme, a product range or a group product with component parts. Individual roles and responsibilities are allocated and, if necessary, individual design briefs are created as an adjunct to the group design brief.

Individually and in teams, students develop evaluation criteria that are used to determine the success of the collaboration and the individual contributions. Students justify the criteria and devise a checking method for the finished product to determine if each criterion has been met.

The product students develop demonstrates an understanding of human-centred design factors. This area of design analyses the interactions between humans and their made environment to maximise wellbeing and product/system performance. Students also consider other relevant Product design factors (page 14). They research suitable materials and processes needed to make the product. Students share research gathered from primary and secondary sources.

Students investigate an historical and/or a cultural design movement or style for inspiration. These movements or styles include but are not restricted to Bauhaus, Art Deco, Memphis, Minimalism, or Organic Design Style, oriental, Gothic, music genres and fashion houses.

Drawings produced during the design and development stage of the Product design process are shared with others and evaluated to gain feedback from team members. A preferred option is justified with reference to group feedback and approval. Students must record their individual contribution to the team.

Students develop skills in project management and in presenting their work to others, replicating processes used in the real world. Using case studies, students explore how ICT facilitates collaborative product design in a global environment.

Outcome 1

On completion of this unit the student should be able to design and plan a product, a product range or a group product with component parts in response to a design brief based on a common theme, both individually and within a team.

To achieve this outcome the student will draw on key knowledge and key skills outlined in Area of Study 1.

Key knowledge

- the Product design process and its application to achieve a product developed within a collaborative team environment
- methods of using primary and secondary resources to research a design need and ways of collaborating with a team to share results
- methods of using ICT to support collaboration in the product design process in a global environment
- social protocols and tools and techniques for working in an online collaborative environment
- methods of applying the Product design factors in a design brief
- human-centred design factors and how they influence the design of products
- social, economic, and environmental issues of sustainability related to design
- the purpose and structure of a design brief and methods of establishing evaluation criteria from a design brief
- methods of presenting research and ideas using test reports, image/mood boards, material and product samples, diagrams, charts and drawings
- historical and/or cultural design movements or styles and how they can inspire new product designs
- creative and critical design thinking methods and techniques to generate and select ideas
- the purpose of annotations in visualisations (concept sketches and drawings), design options and working drawings to explain product functions, materials and construction methods
- the purpose and value of feedback to inform the selection and justification of viable design solutions
- the role of ICT and computer-aided design to communicate assembly, exploded views and design details as appropriate
- methods used to determine appropriate, efficient and effective production processes to make a product, including marking out, cutting, shaping, joining and finishing procedures
- the role and content of production planning, including:
  - detailed work plan showing tools, equipment and machinery
  - a timeline
  - materials list and costing
  - quality measures
  - risk assessment.

Key skills

- develop a design brief with relevant Product design factors
- develop and use criteria to evaluate contributions to the team and devise methods to check how the completed product will meet each criterion
- develop evaluation criteria to assess the sustainability of the design
- identify and allocate responsibilities within the team to conduct and share research
- investigate an historical and/or a cultural design movement or style
- justify selection of materials based on their suitability and sustainability
- implement the design and development stage of the Product design process using ICT as appropriate
- provide critical and constructive feedback and justify preferred option selection
- present design work to other members of the group
- devise a production plan with reference to working drawings.

AREA OF STUDY 2

Producing and evaluating a collaboratively designed product

In this area of study, students apply knowledge, skills, techniques and processes (including risk management) to make their product/s designed in Area of Study 1 and in accordance with the team requirements. The team refers to the historical and/or cultural design movement or style that inspired their designs to ensure consistency throughout production. To facilitate communication, students may use digital collaborative design and project management tools.

Students use appropriate methods of recording production processes and make modifications to production plans. They evaluate their use of materials, tools, equipment, machines, techniques and processes in transforming design options into a product range or team-designed product. Products (or components) are tested and checked and evaluated to determine how well each meets the requirements of the design brief. Students evaluate their own and others' contributions to the team. They evaluate the social, economic and environmental sustainability factors related to the materials and the products.

Outcome 2

On completion of this unit the student should be able to justify, manage and use appropriate production processes to safely make a product and evaluate, individually and as a member of a team, the processes and materials used, and the suitability of a product or components of a group product against the design brief.

To achieve this outcome the student will draw on key knowledge and key skills outlined in Area of Study 2.

Key knowledge

- production techniques for the use of materials, tools, equipment and machines, including risk management to safely make the product
- digital and manual methods of recording progress through production, including any modifications to the production plans

- methods of evaluating the suitability of the group product/s as a solution to the design brief, including:
  - checking the product/s in relation to predetermined evaluation criteria
  - extent to which the product was influenced by an historical and/or a cultural design movement or style with consideration of human-centred design factors and sustainability
  - observations and feedback from others
  - suggestions for improvements
- methods to evaluate design, planning and production activities of the team as a group of designer-makers, including:
  - feedback on the productivity of individuals within the group and ability to collaborate
  - comparison of production plans with record of progress
  - usefulness of working drawings
  - suitability of processes
  - effective use of time and resources
  - suggestions for improvements.

Key skills

- work individually and as a team member to safely make the product or product components
- use risk management and safely use materials, tools, equipment and machines
- individually record progress, decisions made and modifications to the preferred design option and production plans
- evaluate the completed product/s to determine how they satisfy the design brief with reference to inspiration from historical and/or cultural design movements or styles, human-centred design factors and related sustainability factors
- evaluate, individually and collaboratively, the design, planning and production activities.

ASSESSMENT

The award of satisfactory completion for a unit is based on a decision that the student has demonstrated achievement of the set of outcomes specified for the unit. This decision will be based on the teacher's assessment of the student's overall performance on assessment tasks designated for the unit.

The key knowledge and key skills listed for each outcome should be used as a guide to course design and the development of learning activities. The key knowledge and key skills do not constitute a checklist and such an approach is not necessary or desirable for determining the achievement of outcomes. The elements of key knowledge and key skills should not be assessed separately.

Assessment tasks must be a part of the regular teaching and learning program and must not unduly add to the workload associated with that program. They must be completed mainly in class and within a limited timeframe. Teachers should select a variety of assessment tasks for their assessment program to reflect the key knowledge and key skills being assessed and to provide for different learning styles.

For this unit students are required to demonstrate achievement of two outcomes. As a set these outcomes encompass both areas of study.

Demonstration of achievement of Outcomes 1 and 2 must be based on the student's performance on a selection of assessment tasks. Where teachers allow students to choose between tasks they must ensure that the tasks they set are of comparable scope and demand.

Assessment tasks for this unit are selected from the following:

- design folio that contains a design brief, evaluation criteria, research, visualisations and design options, working drawings, production plan, and evaluation report
- product and records of production and modifications
- multimedia presentation supported by speaker's notes
- short written report that includes materials testing or trialling activities, industry visits, technical reports
- oral report supported by notes and/or visual materials.

Unit 3: Applying the Product design process

In this unit students are engaged in the design and development of a product that meets the needs and expectations of a client and/or an end-user, developed through a design process and influenced by a range of complex factors. These factors include the purpose, function and context of the product; human-centred design factors; innovation and creativity; visual, tactile and aesthetic factors; sustainability concerns; economic limitations; legal responsibilities; material characteristics and properties; and technology. Design and product development and manufacture occur in a range of settings. An industrial setting provides a marked contrast to that of a 'one-off situation' in a small 'cottage' industry or a school setting. Although a product design process may differ in complexity or order, it is central to all of these situations regardless of the scale or context. This unit examines different settings and takes students through the Product design process as they design for others.

In the initial stage of the Product design process, a design brief is prepared. It outlines the context or situation around the design problem and describes the needs and requirements in the form of constraints or considerations.

In Area of Study 1, students examine how a design brief is structured, how it addresses particular Product design factors and how evaluation criteria are developed from the constraints and considerations in the brief. They develop an understanding of techniques in using the design brief as a springboard to direct research and design activities.

In Area of Study 2, students examine how a range of factors, including new and emerging technologies, and international and Australian standards, influence the design and development of products within industrial manufacturing settings. They consider issues associated with obsolescence and sustainability models.

In Area of Study 3, students commence the application of the Product design process for a product design for a client and/or an end-user, including writing their own design brief which will be completed and evaluated in Unit 4.

AREA OF STUDY 1

The designer, client and/or end-user in product development

In this area of study students examine the Product design process and develop skills in writing a design brief, which is vital for the development of a viable solution. They focus on the role of the designer and the relationship between a designer, client and/or end-user/s of an intended product. They consider methods used to establish a client's and/or an end-user's needs and requirements for the development of a solution to a design problem or to meet a need.

Using problem-based design scenarios provided by the teacher, students identify appropriate Product design factors (page 14) and write a design brief. In the design brief, students outline the context and express the needs and requirements as constraints and considerations. They annotate this design brief and develop evaluation criteria, they identify research needs to learn how design ideas are informed by research.

The design brief developed in Outcome 1 should not be used in Outcome 3 of this unit.

Outcome 1

On completion of this unit the student should be able to explain the roles of the designer, client and/or end-user/s, the Product design process and its initial stages, including investigating and defining a design problem, and explain how the design process leads to product design development.

To achieve this outcome the student will draw on key knowledge and key skills outlined in Area of Study 1.

Key knowledge

- the stages, steps and goals of the Product design process
- Product design factors that influence the designer
- the relationship between the designer, client and/or end-user/s and their respective roles
- methods of exploring the Product design factors as specified by the client or identified for a user group through the use of appropriate market research
- the role, purpose, structure and components of a design brief, including a situation or context and constraints and considerations
- how a designer collects, records and develops relevant information about the design problem and the specific needs and requirements of the client and/or end-user/s to create a design brief, including reference to Product design factors
- the purpose and structure of relevant four-part evaluation criteria, including for each criterion:
  - the evaluation criterion written as a question
  - its justification and relevance to the design brief
  - how it could be achieved
  - how the completed product could be tested or checked against the criterion
- the relationships between the design brief, evaluation criteria, research and product design development activities.

Key skills

- describe the stages and explain the goals of each step of the Product design process
- explain the role of a designer and the relationship between a designer, client and/or an end-user of a product
- develop a design brief
- identify aspects within a design brief that require research that will influence design activities
- explain methods and activities from the highlighted information that the designer could undertake to research, explore and develop creative design ideas and design options to meet the requirements of the design brief
- develop four-part evaluation criteria based on the design brief.

AREA OF STUDY 2

Product development in industry

In this area of study students focus on the factors, processes and systems that influence the design and development of products within industrial settings. Students explore specific cases and the reasons why design and innovation is integral to value adding to products. In these case studies, they also examine how companies react to market demands and technological developments. Students look at the role of market research in determining consumer needs in relation to sustainability. They also examine market research and the Five Ps (people, product, place, promotion and price) of marketing in relation to the product development process.

Students investigate the use of computer-aided design and manufacture and emerging technologies used in industry. They develop an understanding of a range of issues relating to marketing, innovation, designing, research and development, obsolescence and sustainability in an industrial manufacturing context.

Outcome 2

On completion of this unit the student should be able to explain and analyse influences on the design, development and manufacture of products within industrial settings.

To achieve this outcome the student will draw on key knowledge and key skills outlined in Area of Study 2.

Key knowledge

- the types and roles of manufacturing industry sectors
- the role of research and development (R&D) and their importance for industry
- the importance of new and emerging technologies, materials and processes and their influence on product design, including:
  - laser technology, robotics, computer-aided design (CAD), computer-aided manufacture (CAM), computer numerical control (CNC) and rapid 3-d prototyping
  - lean manufacturing
- purposes of international and Australian standards to ensure safety, consistency and quality of products
- design and innovation and its importance in the product development process
- the relationship between market research and the Five Ps of marketing within the product development process
- sustainability systems and models that influence design, production and distribution, including:
  - Design for the Environment (DfE)
  - Life Cycle Analysis (LCA)
  - cradle to cradle concept
  - Design for Disassembly (DfD)
  - Extended Producer Responsibility (EPR) or Product stewardship
- style, technical and functional obsolescence, and the benefits and problems for the producer and consumer, and associated environmental issues
- the importance of OH&S in manufacturing
- methods and suitability of different scales of manufacturing systems, including one-off, low-volume and continuous (volume) production.

Key skills

- explain the role of manufacturing and the importance of research and development
- explain and analyse the use of new and emerging technologies, including new materials and processes in an industrial setting
- describe the purpose of international and Australian standards
- graphically represent and describe the product development process in industry
- analyse the benefits and problems of obsolescence
- explain and analyse the systems and models of sustainability that influence design, manufacturing and marketing in industry
- compare one-off, low-volume and continuous manufacturing systems and the types of products that result from these production methods.

AREA OF STUDY 3

Designing for others

In this area of study students focus on working as a designer and applying the Product design process (page 12) to meet the needs and requirements of a client and/or an end-user. Students identify specific needs of the client and/or an end-user by referring to the Product design factors (page 14) and conducting research. Students prepare a design brief that governs their work for both this area of study and Areas of Study 2 and 3 in Unit 4. They examine appropriate techniques for recording and communicating data, information, visualisation of ideas, design options and working drawings and obtaining client and/or end-user feedback. They appropriately acknowledge resources and IP of others. Students use creative and critical design thinking techniques throughout the Product design process.

Students develop evaluation criteria for the design options and a decision matrix to assign a numerical weighting to each of the evaluation criteria according to their degree of importance. The decision matrix is applied to each design option, to determine the preferred option. It is supported with a written statement to reflect decision making. Following justification of the preferred option, students develop working drawings using appropriate technical language and conventions. Students also develop four-part evaluation criteria for the finished product and evaluation criteria for the design, planning and production activities.

Production planning includes: material testing or trialling, selection and procurement; selection of appropriate production processes, including some which are complex, their sequence and a timeline; risk assessment; and development of product specifications and identification of quality measures. Suitable materials are to be selected from those listed on page 15. After commencing production, students document their progress and explain and justify production modifications.

Outcome 3

On completion of this unit the student should be able to present a folio that documents the Product design process used while working as a designer to meet the needs of a client and/or an end-user, and commence production of the designed product.

To achieve this outcome the student will draw on key knowledge and key skills outlined in Area of Study 3.

Key knowledge

- the Product design process and its application to achieve a quality product for a client and/or an end-user
- methods of accessing, analysing, organising and presenting relevant data and information used to determine the needs of a client and/or an end-user
- Product design factors relevant to identified problems, needs or requirements
- methods used by designers to develop, use and present a design brief that includes the context, constraints and considerations, and expected quality of the finished product
- the purpose of developing and weighting criteria in a decision matrix for the evaluation of design options based on the constraints and considerations for the selection of the preferred option
- the role of four-part evaluation criteria and how they are developed from the design brief to evaluate the finished product
- the role and purpose of evaluation criteria to determine the efficiency and effectiveness of design, planning and production activities
- methods of exploring, researching and testing the characteristics and properties of materials, fittings and fastenings to determine their suitability; and processes applicable to the development of the design
- methods of developing design ideas, including use of creative and critical design thinking techniques, and ICT tools where appropriate; and ways of communicating these and gaining feedback from the client and/or an end-user
- the purpose and role of visualisations (annotated concept sketches and drawings), design options (annotated presentation drawings) and working drawings of the justified preferred option
- methods of communicating a product specification in working drawings, including assembly and detail drawings, templates, flats, plans, patterns and notations as appropriate
- availability and appropriateness of tools, equipment, machinery, facilities and other factors that influence productivity
- the role and components of the production plan, including:
  - an overall timeline/Gantt chart showing how the product will be completed within the allocated time frame
  - a detailed work plan showing processes, materials, tools, equipment and machines; and estimated time to complete processes
  - risk assessment
  - a materials and costing list with fittings and fastenings as required
  - measures to ensure quality
- techniques used to record progress and reasons for modifications to the design, planning and production plans.

Key skills

- interview and profile a client/an end-user
- develop a design brief with reference to Product design factors
- develop evaluation criteria for the decision matrix, finished product; and design, planning and production activities
- conduct and present research relevant to the design brief, appropriately acknowledging sources and respecting IP of others
- use a range of visualisations, drawing and communication methods, including ICT where appropriate, for the design and development stage of the Product design process and appropriately acknowledge IP and other sources of information

- use a decision matrix to select and then justify the preferred design option in conjunction with the client and/or an end-user and develop appropriate working drawings to show its specifications
- prepare a production plan with reference to the working drawings and product specifications
- research, test, use experimentation techniques and/or trial processes to ascertain appropriateness of characteristics and properties of materials for the product design
- safely and efficiently begin to implement production activities, record progress and explain and justify modifications and improvements.

ASSESSMENT

The award of satisfactory completion for a unit is based on a decision that the student has demonstrated achievement of the set of outcomes specified for the unit. This decision will be based on the teacher's assessment of the student's overall performance on assessment tasks designated for the unit. The Victorian Curriculum and Assessment Authority publishes online an assessment handbook for this study that includes advice on the assessment tasks and performance descriptors for assessment.

The key knowledge and key skills listed for each outcome should be used as a guide to course design and the development of learning activities. The key knowledge and key skills do not constitute a checklist and such an approach is not necessary or desirable for determining the achievement of outcomes. The elements of key knowledge and key skills should not be assessed separately.

Assessment of levels of achievement

The student's level of achievement in Unit 3 will be determined by School-assessed Coursework, a School-assessed Task and an end-of-year examination.

Contribution to final assessment

School-assessed Coursework for Unit 3 will contribute 12 per cent.

The level of achievement for Unit 3 is also assessed by a School-assessed Task, which will contribute 50 per cent, and an end-of-year examination, which will contribute 30 per cent.

School-assessed Coursework

Teachers will provide to the Victorian Curriculum and Assessment Authority a score representing an assessment of the student's level of achievement.

The score must be based on the teacher's rating of performance of each student on the tasks set out in the following table and in accordance with the assessment handbook published online by the Victorian Curriculum and Assessment Authority. The assessment handbook also includes advice on the assessment tasks and performance descriptors for assessment.

Assessment tasks must be a part of the regular teaching and learning program and must not unduly add to the workload associated with that program. They must be completed mainly in class and within a limited timeframe. Where teachers provide a range of options for the same assessment task, they should ensure that the options are of comparable scope and demand. Teachers should select a variety of assessment tasks for their program to reflect the key knowledge and key skills being assessed and to provide for different learning styles.

Outcomes	Marks allocated*	Assessment tasks
Outcome 1 Explain the roles of the designer, client and/or end-user/s, the Product design process and its initial stages, including investigating and defining a design problem, and explain how the design process leads to product design development.	25	A structured, annotated design brief, four-part evaluation criteria and an explanation of how the designer will research and develop design ideas from the design brief, with reference to key words and phrases.
Outcome 2 Explain and analyse influences on the design, development and manufacture of products within industrial settings.	35	Any one or a combination of: • a test (short and/or extended response) • a short written report • a report in multimedia format • an oral presentation accompanied by speaker notes.
Total marks	**60**	

*School-assessed Coursework for Unit 3 contributes 12 per cent.

School-assessed Task

Assessment for Product Design and Technology includes a School-assessed Task. The student's level of performance in achieving Outcome 3 in Unit 3 and Outcomes 2 and 3 in Unit 4 will be assessed through a School-assessed Task using criteria published annually and available on the Product Design and Technology study page on the Victorian Curriculum and Assessment Authority website. Details of the School-assessed Task for Units 3 and 4 are provided on page 37 of this study design.

Unit 4: Product development and evaluation

In this unit students learn that evaluations are made at various points of product design, development and production. In the role of designer, students judge the suitability and viability of design ideas and options referring to the design brief and evaluation criteria in collaboration with a client and/or an end-user. Comparisons between similar products help to judge the success of a product in relation to a range of Product design factors. The environmental, economic and social impact of products throughout their life cycle can be analysed and evaluated with reference to the Product design factors.

In Area of Study 1, students use comparative analysis and evaluation methods to make judgments about commercial product design and development.

In Area of Study 2, students continue to develop and safely manufacture the product designed in Unit 3, Outcome 3, using materials, tools, equipment and machines, and record and monitor the production processes and modifications to the production plan and product.

In Area of Study 3, students evaluate the effectiveness and efficiency of techniques they used and the quality of their product with reference to evaluation criteria and client and/or end-user feedback. Students make judgments about possible improvements. They produce an informative presentation to highlight the product's features to the client and/or an end-user and explain its care requirements.

AREA OF STUDY 1

Product analysis and comparison

In this area of study students examine design factors that influence the success or otherwise of commercially available products. Products are analysed and evaluated in terms of the Product design factors (page 14). Students develop an understanding of what people value and how they make judgments about products using qualitative and quantitative methods, and consider the impacts and consequences of product design success and failure.

Students examine types of comparative tests used to determine how well similar products fulfil their purpose. For the purposes of this area of study, commercially produced products should be used.

Outcome 1

On completion of this unit the student should be able to compare, analyse and evaluate similar commercial products, taking into account a range of factors and using appropriate techniques.

To achieve this outcome the student will draw on key knowledge and key skills outlined in Area of Study 1.

Key knowledge

- qualitative and quantitative methods of evaluating products, including user trials, research of users, and expert appraisal methods of product evaluation
- methods of comparative testing for different versions and models of products
- methods of establishing criteria to evaluate products, including relevant Product design factors
- environmental, economic and social issues associated with products that may be of concern and consequence to potential purchasers and users
- how designers, manufacturers, users and owners prioritise and place value on product attributes and how these values vary over the life cycle of a product
- key factors and aspects that determine the quality of a product.

Key skills

- develop criteria for analysing and evaluating commercial products based on relevant Product design factors
- explain how attributes of products are prioritised
- compare and evaluate the attributes of similar commercial products
- analyse the sustainability of selected similar commercial products
- evaluate the quality of a commercial product compared to other similar products.

AREA OF STUDY 2

Product manufacture

This area of study focuses on the skills, production techniques and processes employed to make a product to suit the needs of a client and/or an end-user. Students continue to implement their production plan, apply skills and processes including risk management in the safe use of materials, tools, equipment and machines, and complete the product to specified standards of quality. They monitor and record their progress and make modifications if necessary in consultation with the client and/or end-user.

Students select appropriate construction materials from the list on page 15.

Outcome 2

On completion of this unit the student should be able to safely apply a range of production skills and processes to make the product designed in Unit 3, and manage time and resources effectively and efficiently.

To achieve this outcome the student will draw on key knowledge and key skills outlined in Area of Study 2.

Key knowledge

- risk assessment associated with selecting and using tools, equipment, machinery, materials, chemicals and other substances
- a range of processes and techniques involving different degrees of difficulty associated with the manufacture of a specific product
- goal setting, and time and resource project management techniques
- quality measures applicable to the production process
- techniques of monitoring efficiency and effectiveness of planning and production activities
- methods used to gain feedback, and record and report progress, including decisions and modifications made during the production process.

Key skills

- apply risk management throughout production
- competently and safely use materials, fittings and fastenings (as appropriate), tools, equipment and machines
- use appropriate processes safely and accurately to make a safe, functional product
- use quality measures to ensure a quality outcome is achieved
- use appropriate communication techniques to record and report progress, and modifications on production activities, to the client and/or end-user
- use ICT where appropriate.

AREA OF STUDY 3

Product evaluation

In this area of study students use evaluation criteria, carry out checks and tests, and gain client and/or end-user feedback to determine how well their product meets the needs and requirements outlined in the design brief developed in Unit 3. The effectiveness of planning and efficiency of the production processes are also evaluated. Students consider how their findings can be used to inform the design process for future projects.

Students highlight features of the product they have designed and made in a presentation for their client and/or an end-user. Through the inclusion of a care label, they advise on methods of caring for the product to prolong its life and maintain its appearance and function.

Outcome 3

On completion of this unit the student should be able to evaluate the outcomes of the design, planning and production activities, explain the product's design features to the client and/or an end-user and outline its care requirements.

To achieve this outcome the student will draw on key knowledge and key skills outlined in Area of Study 3.

Key knowledge

- techniques to gather client and/or end-user feedback with reference to evaluation criteria for the completed product
- methods of testing and/or checking the completed product as outlined using previously developed evaluation criteria
- methods of examining the effectiveness and efficiency of the design, planning and production activities using evaluation criteria
- techniques of evaluation and analysis to inform improvement of future products and design, planning and production processes
- methods of presenting product features to the client and/or an end-user
- methods of explaining the care requirements of the product to the client and/or end-user to prolong the product's life and maintain its appearance.

Key skills

- use checking or testing methods and explain product performance and possible improvements
- evaluate the extent to which the completed product successfully meets the needs and requirements of the client and/or end-user
- report on the effectiveness and efficiency of the design, planning and production activities and discuss possible improvements
- produce a presentation for the client and/or an end-user, outlining the features of the product and explain its care requirements on a care label.

ASSESSMENT

The award of satisfactory completion for a unit is based on a decision that the student has demonstrated achievement of the set of outcomes specified for the unit. This decision will be based on the teacher's assessment of the student's overall performance on assessment tasks designated for the unit. The Victorian Curriculum and Assessment Authority publishes online an assessment handbook for this study that includes advice on the assessment tasks and performance descriptors for assessment.

The key knowledge and key skills listed for each outcome should be used as a guide to course design and the development of learning activities. The key knowledge and key skills do not constitute a checklist and such an approach is not necessary or desirable for determining the achievement of outcomes. The elements of key knowledge and key skills should not be assessed separately.

Assessment of levels of achievement

The student's level of achievement for Unit 4 will be determined by School-assessed Coursework, a School-assessed Task and an end-of-year examination.

Contribution to final assessment

School-assessed Coursework for Unit 4 will contribute 8 per cent.

The level of achievement for Unit 4 is also assessed by a School-assessed Task, which will contribute 50 per cent, and an end-of-year examination, which will contribute 30 per cent.

School-assessed Coursework

Teachers will provide to the Victorian Curriculum and Assessment Authority a score representing an assessment of the student's level of achievement.

The score must be based on the teacher's rating of performance of each student on the tasks set out in the following table and in accordance with the assessment handbook published online by the Victorian Curriculum and Assessment Authority. The assessment handbook also includes advice on the assessment tasks and performance descriptors for assessment.

Assessment tasks must be a part of the regular teaching and learning program and must not unduly add to the workload associated with that program. They must be completed mainly in class and within a limited timeframe. Where teachers provide a range of options for the same assessment task, they should ensure that the options are of comparable scope and demand. Teachers should select a variety of assessment tasks for their program to reflect the key knowledge and key skills being assessed and to provide for different learning styles.

Outcomes	Marks allocated*	Assessment tasks
Outcome 1 Compare, analyse and evaluate similar commercial products, taking into account a range of factors and using appropriate techniques.	40	Any one or a combination of: • a test (short and/or extended response) • a short written report • structured questions • a multimedia report • an oral presentation accompanied by speaker notes • an annotated visual report.
Total marks	**40**	

*School-assessed Coursework for Unit 4 contributes 8 per cent.

School-assessed Task

Assessment of Product Design and Technology includes a School-assessed Task worth 50 per cent of the study score. For this assessment teachers will provide to the Victorian Curriculum and Assessment Authority a score representing an assessment of the student's level of performance in achieving Outcome 3 in Unit 3 and Outcomes 2 and 3 in Unit 4 according to criteria published annually and available on the Product Design and Technology study page on the Victorian Curriculum and Assessment Authority website.

Outcomes	Assessment tasks
Unit 3 **Outcome 3** Present a folio that documents the Product design process used while working as a designer to meet the needs of a client and/or an end-user, and commence production of the designed product.	A design folio comprising: A client and/or an end-user profile, a design brief, evaluation criteria, research, visualisations, design options with decision matrices and justification of the selected option, working drawings of final option, production plan and record of progress and modifications. The design folio must include documentation of decisions, and acknowledge sources of information.
Unit 4 **Outcome 2** Safely apply a range of production skills and processes to make the product designed in Unit 3, and manage time and resources effectively and efficiently.	Production work accompanied by a record of production progress, documentation of decisions and modifications with justification of these changes (text and images should be included). **AND** A functional product that conforms to standards of quality.
Outcome 3 Evaluate the outcomes of the design, planning and production activities, explain the product's design features to the client and/or an end-user and outline its care requirements.	An evaluation report that includes evaluation of the product and the design, planning and production processes. **AND** An informative presentation to highlight the features of the product in any of the following formats: • annotated image of the product • multimedia • image and commentary **AND** A care label.

End-of-year examination

Description

The examination will be set by a panel appointed by the Victorian Curriculum and Assessment Authority. All the key knowledge and key skills that underpin the outcomes in Units 3 and 4 are examinable. Students will not be required to demonstrate practical skills using tools, equipment and machines that are related to the production of their projects; however, their knowledge and understanding of these is examinable. Design brief questions will be based on Category 1 materials.

Conditions

The examination will be completed under the following conditions:

- Duration: one and a half hours.
- Date: end-of-year, on a date to be published annually by the Victorian Curriculum and Assessment Authority.
- Victorian Curriculum and Assessment Authority examination rules will apply. Details of these rules are published annually in the *VCE and VCAL Administrative Handbook*.
- The examination will be marked by assessors appointed by the Victorian Curriculum and Assessment Authority.

Contribution to final assessment

The examination will contribute 30 per cent.

Further advice

The Victorian Curriculum and Assessment Authority publishes specifications for all VCE examinations on the Victorian Curriculum and Assessment Authority website. Examination specifications include details about the sections of the examination, their weighting, the question format/s and any other essential information. The specifications are published in the first year of implementation of the revised Units 3 and 4 sequence together with any sample material.

Advice for teachers

The Victorian Essential Learning Standards (VELS) is the curriculum framework for the compulsory years of schooling in Victoria. Links between the VCE Product Design and Technology study and the VELS are shown below.

VCE Product Design and Technology provides students with opportunities to develop employability skills. The links between the forms of assessment in the study design and employability skills are provided in the table on page 41.

VICTORIAN ESSENTIAL LEARNING STANDARDS (VELS)

The study of VCE Product Design and Technology builds on knowledge and skills developed in the domains of Interpersonal Development, Communication, Thinking Processes, Personal Learning, Science, Information and Communications Technology.

The key knowledge and key skills in VCE Product Design and Technology builds on the students' understanding gained in the Interpersonal Development dimension of working in teams through learning activities undertaken in Unit 2: Collaborative design. In Outcome 1, students work as a team member to develop the knowledge, skills and behaviours that enable them to cooperate with others and achieve the team's goals. They contribute to and reflect on the learning which occurs through being part of a team. This is achieved through students working in a design team to generate a group design brief. Individual roles and responsibilities are allocated and students develop evaluation criteria that are used to determine the success of the collaboration and the individual contributions. In Outcome 2 students apply skills, techniques, processes and knowledge to make their product/s in accordance with the team requirements. Students can further develop their ability to contribute to team goals and work cooperatively by supporting each other during these activities. Students evaluate individual contributions to the team.

The skills underpinning the Presenting dimension of the Communication domain enable students to develop their ability to present information clearly and confidently. Further development of these skills occurs throughout this VCE study as students read and interpret information such as case studies or production plans. They also create documents using a range of presentation techniques such as annotated visual displays, multimedia presentations or online communication products. They further develop their ability to present findings clearly and concisely through Units 3 and 4 with the presentation of the design folio and analysing and evaluating commercially available products.

The domain of Thinking Processes encourages students to reason, process information, develop their creativity and to reflect on and evaluate their ideas. When working through the design process in all units of VCE Product Design and Technology, students build on the thinking skills gained in earlier years. When developing solutions to complex design briefs, students use their problem-solving skills, analyse complex information, generate creative solutions to problems and reflect on and refine their ideas.

Through the domain of Personal Learning, students work towards becoming positive, confident and successful learners. Throughout all units of Product Design and Technology, students build on these skills, particularly when they are engaged in designing and developing a solution in response to a design brief. As they complete design activities, students set goals and plan the use of resources, including time management. Students also undertake multiple tasks within the one activity and evaluate and monitor their own performance, seeking feedback from others.

Students further develop their understanding of the domain of Science knowledge and understanding in Unit 1, Outcome 1 through their study of origins, sources and classification of materials with consideration of their sustainability properties. This unit also includes research into the characteristics of materials related to the economic, environmental and social implications of their design solutions and sustainability. Product Design and Technology builds skills in the dimension of Science at work through the use of the scientific method for conducting investigations, which incorporates the use of equipment, taking measurements, recording data, and drawing conclusions. This is seen in Units 1 and 3 when students conduct materials tests. In all units students further their understanding and completion of risk assessments when undertaking production processes, using materials, chemicals and equipment. This covers the use of Material Safety Data Sheets and OH&S regulations.

Students build on skills and knowledge gained through Information and Communications Technology (ICT) through visualising thinking. Students use graphic organisers in Units 1 to 3 to assist in developing their designs. In Units 1 to 3 they use ICT for communicating and presenting design options using CAD. They use ICT to communicate with others in Unit 2 as they explore various ICT methods to support collaboration in the Product design process, with the purpose of remotely seeking and discussing alternative views. They explore how ICT facilitates collaborative product design in a global environment. Students also locate information from a range of online and multimedia resources to support their own learning.

EMPLOYABILITY SKILLS

Units 1 to 4 of the VCE Product Design and Technology study provide students with the opportunity to engage in a range of learning activities. In addition to demonstrating their understanding and mastery of the content and skills specific to the study, students may also develop employability skills through their learning activities.

The nationally agreed employability skills* are: Communication; Planning and organising; Teamwork; Problem solving; Self-management; Initiative and enterprise; Technology; and Learning.

Each employability skill contains a number of facets that have a broad coverage of all employment contexts and are designed to describe all employees. The table below links those facets that may be understood and applied in a school or non-employment related setting, to the types of assessment commonly undertaken within the VCE study.

*The employability skills are derived from the Employability Skills Framework (*Employability Skills for the Future*, 2002), developed by the Australian Chamber of Commerce and Industry and the Business Council of Australia, and published by the (former) Commonwealth Department of Education, Science and Training.

Assessment task	Employability skills: selected facets
Annotated visual display	**Communication** (sharing information)
Case study	**Communication** (sharing information) **Planning and organising** (planning the use of resources, including time management; collecting, analysing and organising information) **Technology** (using IT to organise data)
Designing and developing a solution in response to a design brief (design folio)	**Communication** (sharing information) **Teamwork** (working as an individual and as a member of a team; knowing how to define a role as part of the team) **Problem solving** (developing practical solutions) **Initiative and enterprise** (generating a range of options; initiating innovative solutions; being creative) **Planning and organising** (planning the use of resources, including time management; collecting, analysing and organising information) **Self management** (evaluating and monitoring own performance) **Learning** (managing own learning) **Technology** (using IT to organise data)
Multimedia presentation	**Communication** (sharing information; speaking clearly and directly; writing to the needs of the audience) **Planning and organising** (collecting, analysing and organising information) **Self management** (evaluating and monitoring own performance) **Technology** (having a range of basic IT skills; using IT to organise data; being willing to learn new IT skills)
Practical tests	**Teamwork** (working as an individual and as a member of a team; knowing how to define a role as part of the team) **Problem solving** (applying a range of strategies to solve problems) **Planning and organising** (planning the use of resources, including time management)
Production activities	**Communication** (listening and understanding) **Teamwork** (working as an individual and as a member of a team) **Problem solving** (developing practical solutions) **Initiative and enterprise** (generating a range of options; initiating innovative solutions; being creative) **Planning and organising** (planning the use of resources, including time management; managing time and priorities – setting timelines, coordinating tasks for self and with others) **Self management** (evaluating and monitoring own performance; seeking feedback) **Learning** (managing own learning)
Report (oral/written/visual)	**Communication** (sharing information; speaking clearly and directly; writing to the needs of the audience; using numeracy) **Planning and organising** (collecting, analysing and organising information) **Technology** (using IT to organise data)
Structured questions	**Communication** (writing to the needs of the audience) **Planning and organising** (planning the use of resources, including time management) **Problem solving** (applying a range of strategies to problem solving) **Self management** (evaluating and monitoring own performance)
Test (short and/or extended answer)	**Communication** (writing to the needs of the audience) **Planning and organising** (planning the use of resources, including time management) **Problem solving** (applying a range of strategies to problem solving)

DEVELOPING A COURSE

A course outlines the nature and sequence of teaching and learning necessary for students to demonstrate achievement of the set of outcomes for a unit. The areas of study broadly describe the learning context and the knowledge required for the demonstration of each outcome. Outcomes are introduced by summary statements and are followed by the key knowledge and key skills which relate to the outcomes.

Teachers must develop courses that include appropriate learning activities to enable students to develop the key knowledge and key skills identified in the outcome statements in each unit.

For Units 1 and 2, teachers must select assessment tasks from the list provided. Tasks should provide a variety and the mix of tasks should reflect the fact that different types of tasks suit different knowledge and skills and different learning styles. Tasks do not have to be lengthy to make a decision about student demonstration of achievement of an outcome.

In Units 3 and 4, assessment is more structured. For some outcomes, or aspects of an outcome, the assessment tasks are prescribed. The contribution that each outcome makes to the total score for School-assessed Coursework is also stipulated.

Unit 3, Outcome 3 and Unit 4, Outcomes 2 and 3 are assessed by a School-assessed Task. The School-assessed Task will initially be assessed by teachers using criteria published by the Victorian Curriculum and Assessment Authority and will be subject to external review.

One of the most important issues for teachers to consider when planning a course is to ensure that practical activities are embedded into the course to engage students in learning.

The use of the Product design process and the Product design factors is integral to all units of this study.

To help students understand the Product design factors and related parameters on page 14 a suggested exercise is to turn each factor into a question and illustrate with examples. For example, purpose, function, and context could be developed into the following questions:

- What is the purpose or function of the product to be designed?
- What is the reason for its development?
- Who needs it?
- Where and when will it be used?

Students will need to refer to these factors, the related parameters and the questions when they write design briefs, discuss and annotate designs and analyse products in all units.

It is acknowledged that many different models of the design process exist. These models aim to represent how designers or designer-makers start with a need, problem or opportunity that materialises into a product as a result of a series of cognitive and physical activities. The Product design process outlines the stages students in this study will work through that replicates processes that many designers use to change their initial design concepts into a product. In industry, this process varies according to the company, the product and the experience of the designers. In this study the Product design process provides a structure for students to work through to realise their own design ideas.

The Investigating and defining stage requires the clarification of a need, problem or opportunity in a design brief. The design brief should not describe a final solution but should allow room for exploration, creativity and innovation. For more information about developing design briefs, go to Design Awareness in Schools: <http://vels.vcaa.vic.edu.au/support/dais/process.html> on the VELS website.

Students should be encouraged to use ongoing evaluation and reflection by asking themselves whether they are on track with the requirements of the design brief, and whether they are working within the constraints of safety, time and quality that most projects require. However, formal documentation for

evaluation is one of the critical stages in the Product design process. Evaluation criteria are developed in step 3 of the Product design process and responded to in steps 10 and 11. However, students should be encouraged to reflect on their learning and progress throughout the entire design process.

The Design and development (conceptualisation) stage specifies the types of drawings required to communicate designs. The characteristics and purpose of the drawings varies with the communication need. The following table outlines the main types of drawings and their purposes.

Type of drawing	Characteristics of these drawings	Purpose of these drawings
Visualisations	Quick, freehand drawings of ideas that may be whole or parts of an envisaged product. They are usually in pencil using lines and very basic rendering.	Visualisations are informed by research and the student's own ideas to communicate possibilities. They are used to 'work through' potential ideas to take forward into design options.
Design options (presentation drawings)	Generally these drawings show what the whole of the product will look like and include annotations. Design options often include lines, colour, rendering in pencil, markers, and watercolour/wash. Computer-aided design software (CAD) may be used to produce design options.	To provide a good indication to the designer and others of what a potential product could look like. Annotations provide details such as construction methods and link back to the design brief, considerations and constraints and Product design factors.
Working drawings and pattern drafting	These are more refined drawings developed from a design option or combination of options. These drawings include technical language and conventions, use of symbols and measurements. Technical instruments and CAD are often used to produce working drawings.	Accurately shows what the product looks like and how it will be constructed. These drawings are used to work out product specifications (materials, parts and sizes needed to make the product). They could be used along with a scale model to show specific details before a prototype or product is made.

It is expected that students will annotate visualisations and drawings. Annotations are critical because they provide explanatory notes and comments that link back to the design brief, considerations and constraints.

EQUIPMENT REQUIREMENTS

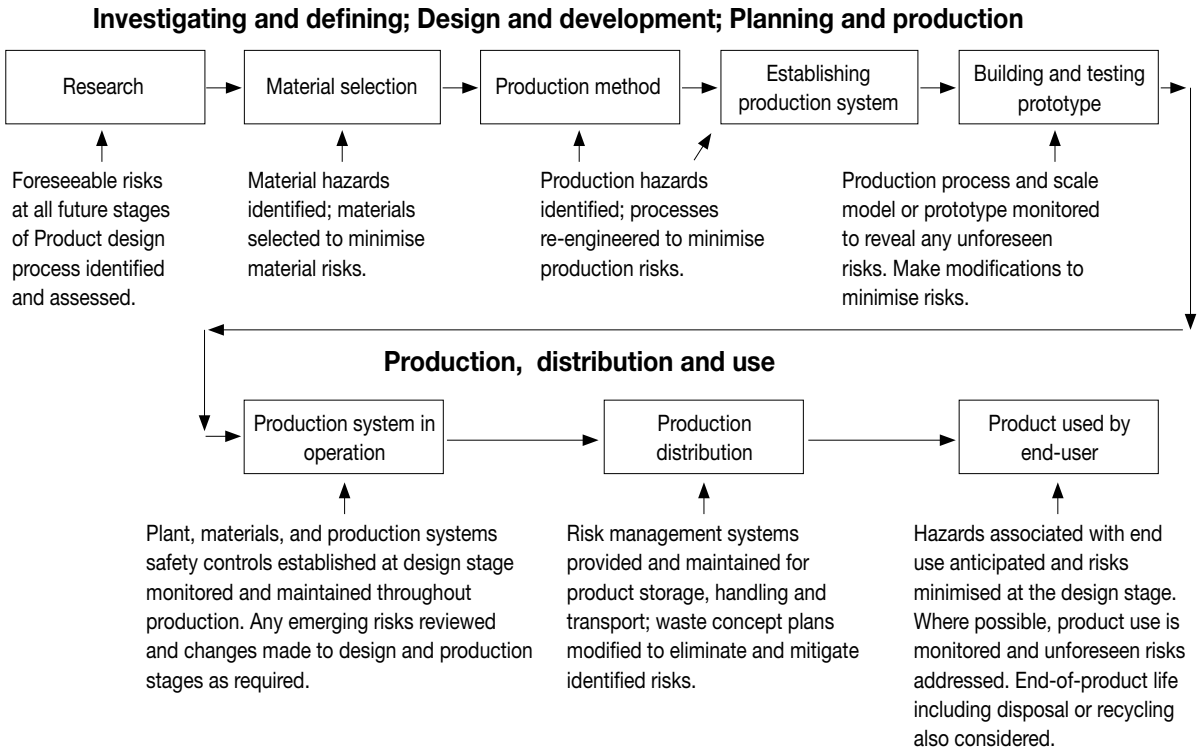
Students are expected to experience a range of processes, from simple to more complex. They will be required to safely use hand tools, equipment and portable and fixed machines, to execute these processes in ways that are relevant to their choice of materials.

Tools, equipment and machines may include but are not restricted to:

- CAD/CAM equipment for designing, cutting, routing
- Marking and measuring tools and equipment, for example rulers, tailors chalk
- Cutting tools for removal of material, including scissors, saws, drills
- Hammering, hitting and forming tools, for example hammers, mallets, forming equipment, lathe, pottery wheel
- Construction and fabrication tools, equipment and machines, for example sewing machine, soldering iron, welder, glue gun
- Decorating and finishing equipment, for example screen printing equipment, spray gun, iron, sander

RISK MANAGEMENT

Students need to include risk assessment throughout the Product design process. In addition, they must consider safety of the end-user of the product. The following diagram shows risk assessment at the design stage and risk management in production.



Source: Paul O'Halloran, *Employee Health*, Department of Education & Training, Victoria (2006)

GLOSSARY

For the purposes of this study design the following definitions will apply.

Term	Definition
Aesthetics	The perception, appreciation of and sensitivity towards works of art, designs, products, objects or artefacts; usually associated with the notion of beauty.
Anthropometrics	A branch of ergonomics that deals with body measurements, including size, strength and physical capacity.
Continuous (volume) production	Production system used for large-scale mechanised production of products. It is economical because of the high numbers of products produced. There is little need to adjust machinery and processes, which produces a time benefit.

Decision matrix	Qualitative or quantitative values arranged in rows and columns that enable a systematic analysis and rating of the strengths of design options. A decision-making tool that lists evaluation criteria taken from a design brief that are then assigned a weighting to determine the most appropriate design option.
Design brief scenario	A written statement that contains an outline of a situation, context, or problem/need. It focuses on the desired results related to the design of a product. The scenario is often a simplified version of a situation, which includes the hypothetical needs and wants of a client and/or an end user.
Computer-aided Design (CAD)	Computer software and hardware is used to draw and design high quality real or virtual products. CAD streamlines design processes for manufacturing and enables a designer to work faster. Computer software allows a design to be quickly modified, and simulate a three-dimensional part or entire product.
Emotional Appeal	The feelings experienced by a user/owner of a product that involve a sense of well being or provides an emotional experience. To make a person feel an emotional connection when they purchase or own a product and that cost or function are of lesser importance than feelings associated with the ownership of the product.
Ergonomics	The application of scientific information about the interaction and relationship of human beings to the design of objects, systems and work and recreational environments. Ergonomics is an important consideration in product design to ensure a product fits the person or worker, reduces the risk of injury or fatigue and improves performance.
Function	Related to a product it means that the product is able to perform a particular task or job that it was designed for or is expected to do. The actions and activities assigned to or required or expected of a product.
GANTT chart	A type of bar chart that represents a schedule of activities or milestones over the time of the project. It shows the start and finish dates for each process or step and is used to pinpoint and assign priorities so that work is completed by a due date.
Human-centred design	Designing products to ensure the needs, safety and comfort of the people they are made for come first or are always taken into consideration.

Term	Definition
Intellectual Property (IP)	Intellectual property is generated through intellectual or creative activity. Types of intellectual property protection include patents, trade marks, design registration, confidential information/trade secrets, copyright, circuit layout rights and plant breeder's rights. See: <www.ipaustralia.gov.au/smartstart/glossary.htm>.
Lean manufacturing	Lean manufacturing or lean production is a system and culture which aims at maximising the output of a manufacturing process with minimal inputs with the help of many lean techniques and tools. It aims at reducing work in progress, downtime, build up of excess raw materials, finished goods, and all waste. Source: <www.leanmanufacture.net/leanterms/leanmanufacturing.aspx>
Life Cycle Analysis (LCA)	Assessing a product's full environmental cost/impact over the life cycle of the product (cradle to grave or cradle). This includes extracting and processing materials, manufacturing, transporting and distribution, use, reuse and maintenance, recycling and final disposal. Quantifies the environmental impact rather than the financial impact.
Low-volume production	Batch or low-volume production systems to produce a small number of items over a given time frame.
Five Ps of marketing	A combination of elements that are used to market or sell a product. The Five Ps of marketing are variables that can be controlled in order to best satisfy customers in a target market. The Five Ps sometimes known as the marketing mix are: product, price, promotion, people and place (physical or virtual).
Mood board	A form of visual stimulus material, such as a large board covered with images.
Obsolescence:	
Style	When a product is no longer wanted by consumers, although it is still functional, but looks outdated.
Technical	A product becomes technically obsolete when it is replaced by a better product with more advanced technology.
Functional	When a product wears out, deteriorates or breaks down after a certain amount of time and parts cannot be replaced, or it is not worth repairing. Planned obsolescence is a term used by Vance Packard denoting a planned condition by a manufacturer to get a consumer to buy a replacement to make more profit for the manufacturer.

Term	Definition
One-off production	A single, often handcrafted article. It can be expensive to make due to the cost of labour but is usually the only one in existence.
Prototype	A prototype is a three-dimensional pre-production product made to test a concept or process. A prototype is often used to enable designers to explore design alternatives, test theories and confirm performance prior to starting production of a new product.
Qualitative	Descriptions or distinctions based on a quality rather than on quantity. Qualitative evaluation of a product refers only to the characteristics of the item being described, rather than being based on a numerical measurement.
Quality measures	A way to measure (quantitatively) the characteristic or attribute of a product. These are methods of checking for quality indicators throughout the production of a product.
Quantitative	A measurement based on some quantity or number rather than on quality. Quantitative research can therefore be used to measure the response from a client to the features of a product.
Rapid three-dimensional prototyping	Manufacturing takes virtual designs from Computer-aided design (CAD) and transforms them into successive layers until the model is complete. The virtual model and the physical model are almost identical. The main advantage is that almost any shape or geometric feature can be created. Source: Wikipedia
Research and development (R&D)	R&D is the systematic investigation or experimentation involving innovation or technical risk. It is aimed at discovering new knowledge that could be useful in creating new products, processes or services or improving existing ones.
Risk management	Risk management comprises four-steps in controlling OH&S hazards and risks: **Step 1:** Identify hazards – know what hazards are present **Step 2:** Assess risks – understand the nature of risks, the harm that could occur and the likelihood **Step 3:** Control hazards and risks – determine options for eliminating or reducing risk, selecting the best and implementing it **Step 4:** Check controls – review the implemented controls to ensure they are working as planned and effective. Controlling OH&S hazards and risks: A handbook for workplaces WorkSafe Victoria: <www.worksafe.vic.gov.au>.

Term	Definition
Scale model	A three-dimensional representation of a design concept usually made in a proportional size to the intended final product often made of different materials from those that will be used in the actual product.
Standards – International and Australian	Detailed technical documents written by experts drawn from industry and government. Products that comply with Australian or International Standards can use the appropriate label (AS or ISO). These products meet the predetermined requirements for example in terms of their size, quality, safety.
Sustainable product design (SPD)	SPD is based on principles of sustainable development which addresses three interrelated areas: environmental stewardship, social equity and justice, and economic issues. SPD is a design philosophy and practice in which products contribute to social and economic wellbeing, have negligible impacts on the environment and can be produced from a sustainable resource base. Faud-Luke, A 2002 *The Eco-Design Handbook*, Thames & Hudson, London
Universal design (also known as inclusive design)	Design that makes products or buildings accessible to as many people as possible regardless of age, ability or stature. The products often have inbuilt-flexibility.
Values (of products)	Values attributed to products change with context, socio-cultural norms, and economic contexts, as new technologies emerge and as products move through their life cycles. Values are determined in socioeconomic settings and on individual terms. The qualities of products that make them valuable include affordability, appearance, authenticity, durability, rarity, status, usability, identity and emotional connection.

SUITABLE RESOURCES

Courses must be developed within the framework of the study design: the areas of study, outcome statements, and key knowledge and key skills.

A list of suitable resources for this study has been compiled and is available via the Product Design and Technology study page on the Victorian Curriculum and Assessment Authority website: <www.vcaa.vic.edu.au/vce/studies/index.html>.

LEARNING ACTIVITIES

Implementation advice and example learning activities for each unit are provided below. Examples in the shaded boxes are explained in detail in accompanying boxes.

Teachers should consider these activities in conjunction with the key knowledge and key skills identified for each outcome within the study.

Unit 1: Product re-design and sustainability

Unit 1: Product re-design and sustainability allows for the completion of a redesigned product or a prototype. A prototype is considered to be the final design of a product before production of multiples or a highly finessed product. The students can therefore make a finished product or a good quality prototype. If appropriate, a prototype made of less expensive materials can be presented for this unit; however, the student will need to precisely indicate the materials intended for the final product.

Unit 1, Outcome 1 key knowledge includes creative and critical thinking skills. Creative and critical thinking skills are used to solve problems in a creative and indirect manner, often associated with 'lateral thinking'. Creative thinking involves the creation or generation of ideas, processes, experiences or objects. Critical thinking is used to evaluate these. Examples of creative thinking include evolution (incremental improvement; new ideas that stem from other ideas), synthesis (two or more ideas are combined into a third), revolution (completely new approach), reapplication (look at something that exists in a new way), and changing direction (shifting attention from one angle or problem to another).

Sustainability (the connection and interaction between social, economic and environmental systems) is included as a Product design factor in the study design. It is introduced in Unit 1, Outcome 1, and involves students considering a case study of a designer/s claim to incorporate sustainability practices into their product designs. Evaluating the sustainability of a product requires an understanding of systems and models used to assess the sustainability of a material or product such as Life Cycle Analysis. Aspects that can be considered as part of Life Cycle Thinking are listed in the table below.

Economic	Environmental	Social
Lean manufacturing	Natural resource depletion	Air quality
Eco-efficiency	Energy use	Water
Life Cycle Assessment	Air pollution	Food/nutrition
Additive manufacturing	Soil contamination	Employment conditions
Design for disassembly	Water conservation	Civil liberties/human rights
Design for efficient distribution	Biodiversity	Culture/values/behaviour
Design for remanufacture	Animal habitat	Consumption
Closed loop manufacture	Waste	Product life extension
Environmental legislation		Design for service/repair
Increased resource productivity		Recycling
Product stewardship		Reuse

Knowledge of intellectual property (IP) is introduced in Unit 1 but it is expected that students respect and acknowledge others' product designs in all units. Students can use others' ideas for inspiration, but should not directly copy a complete design as this would be infringing on IP.

Example activities

AREA OF STUDY 1: Product re-design for improvement

Outcome 1	***Examples of learning activities***
Re-design a product using suitable materials with the intention of improving aspects of the product's aesthetics, functionality or quality, including consideration of sustainability.	using presentation software, present to the class information that explains the different approaches designers have taken to meet a primary need of two or three selected products that have a similar function, e.g. chairs for seating use the Internet, books or magazines to identify two designers who claim to work sustainably and discuss how they address sustainability analyse an existing product design referring to the Product design factors listed in the study design, and identify aspects of the design that can be improved referring to the Product design factors and parameters, annotate either a digital or printed image of an existing product to show a range of potential modifications that could improve the product and explain why using the Life Cycle Analysis (LCA) model, research the sustainability of two disposable products that have the same primary function; link the LCA to environmental, social and economic systems; provide suggestions and a justification for a sustainable alternative product compare a natural to a synthetic/manufactured material (within the same category) using Life Cycle Thinking; for example, Pinus Radiata and chipboard/particle board; woollen material and nylon; steel and aluminium using an existing product, identify and explain how to apply the four stages of the Product design process to the redesign of this product as part of a team, research and compare different creative and critical design thinking methods; identify and use one of these methods to assist in the development of creative design ideas to select the preferred option; consider brainstorming, mind mapping or a SCAMPER checklist as a starting point define patent and the benefits of protecting intellectual property (IP) by referring to the Intellectual Property Australia: <www.ipaustralia.gov.au/> website; look up 'Case Studies' in the Business Strategies link discuss the different types of drawing presentation techniques in the Design and development stage of the Product design process; use these different types of drawings for the redesigned product; to assist, watch a video or vodcast related to the Conceptualisation stage of the Product design process research and present information on the origins, sources and classification of at least two materials from within the same category; for example, conventional cotton and organic cotton; hoop pine and pinus radiata; copper and brass develop, complete and present a materials test for a specific property such as strength, elasticity, or durability; photograph the testing procedures and make written recommendations on the suitability of the materials for specific uses/ applications trial construction/joining techniques and comment on their suitability and application/use for a specific product

develop a production/sequence plan showing the stages for production, tools, equipment and machines to be used and safety procedures to be followed; include quality measures/checks and a modifications section

complete a materials list that includes the costing for all materials, notions and fixtures and fittings used

choose at least two different pieces of equipment to be used during the production of the product that has been re-designed; complete a written risk assessment that identifies the risk/hazard, assesses the level of risk and eliminates or controls the risk

Detailed example

LIFE CYCLE ANALYSIS (LCA) OF TWO PRODUCTS WITH THE SAME PRIMARY FUNCTION

Choose products for LCA/cradle to grave comparison, ensuring the information can be easily found. Allocate the products to paired students.

Using a multimedia presentation, explain the five main stages included in an LCA:

1. extracting and processing raw materials
2. materials processing and manufacturing
3. distribution and packaging
4. product use, maintenance and reuse
5. disposal/end of life.

Use products such as a polystyrene cup, mobile phone, jeans. Identify the most costly stage to the environment and how the impact can be reduced by making changes. For example, make cars lighter using plastic or carbon fibre instead of metal.

Pairs of students complete an Internet search for suitable images and then complete a flow chart or similar visual organiser to show what the LCA is for their selected product.

Draw conclusions about the environmental, social and economic benefit in implementing changes once an LCA has been completed. Useful websites include Powerhouse Museum, Eco-design for Designers on the Design Victoria website and the RMIT Centre for Design.

AREA OF STUDY 2: Producing and evaluating a re-designed product

Outcome 2

Use and evaluate materials, tools, equipment and processes to make a re-designed product or prototype, and compare the finished product or prototype with the original design.

Examples of learning activities

demonstrate to the class the safe and responsible use of a hand tool, piece of equipment or a portable power tool for a particular purpose

using photographs and written comments in a logbook demonstrate the use of processes for selected materials

complete a journal/logbook that documents the activities undertaken to manage the production processes and progress made while making the prototype/product; photographs and written information, that could include annotations, should be used to show management of risks in the use of tools, equipment and machines as well as the different stages of production

complete a written evaluation of the product that has been re-designed that includes responses to the earlier developed evaluation criteria generated from the design brief, constraints and considerations; compare the design to the original showing the three points of difference; suggest how improvements could be made, including references to sustainability

write an evaluation that includes a review of the efficient and effective use of materials, tools, equipment and machines and techniques in design, planning and production activities; make reference to the accuracy and clarity of production plans and working drawings; suitability of production processes, effective planning and use of time and resources (the logbook could be referenced) and suggestions for further improvement

Detailed example

EVALUATING EFFECTIVENESS AND EFFICIENCY OF DESIGN, PLANNING AND PRODUCTION PROCESSES

As a class, search the Internet for definitions of effectiveness and efficiency.

Discuss how the effectiveness and efficiency of design, planning and production activities can be evaluated.

The teacher, using a data projector, demonstrates and discusses how to develop one evaluation criterion, its justification and how it will be tested.

For example:

- Criterion in question form: How effective were the working drawings?
- Justification/context: The drawings need to be effective to ensure the finished product is accurately made to the correct dimensions.
- Test: The measurements on the drawings will be checked using a tape measure against the finished product. They should be correct which will indicate that the drawings are effective and will ensure the product is completed efficiently.

Students cut and paste into a new document the evaluation criteria for their design, planning and production activities developed for Outcome 1.

They then cut and paste their justifications for each criterion.

Students refer back to the proposed test, for example: 'Measure the finished product and check against the working drawing for accuracy'.

Students complete their test and ensure they comment on the effectiveness and efficiency of the design, planning and production activities.

Unit 2: Collaborative design

In Unit 2: Collaborative design, students are expected to work as part of a team, but can design and make a product or a product component in response to a design brief based on a theme. A student can make a product that is part of a range of products or, alternatively, can make a part or component of a product that the team is completing.

Team building skills are an integral component of Unit 2. The teacher will need to negotiate strategies with students that allow and encourage individuals to contribute to their team. In Outcome 1, students expand their understanding of the value of ICT for teamwork by looking at case studies of design teams that use ICT as a communication and collaborative tool. The parts of the design and development that require shared responsibility need to be recorded and evaluated by students, for example using a 'fair contribution' pro forma.

Ergonomics, anthropometric data, safety, comfort and accessibility are included in Unit 2 and are referred to in the Product design factors under human-centred design (human needs and wants) page 14. These are also known as human factors design. Students should be encouraged to research and understand the importance of human-centred design when designing their products, as the safe and comfortable use of products is critical to good design that is fit for purpose.

Unit 2, Outcome 1 requires students to research historical and/or cultural design movements or styles for their design inspiration. There is a wide variety of different movements or styles that can be explored such as Bauhaus, Art Deco, Memphis, Minimalism, Organic Design Style, oriental, Gothic, music genres and fashion houses. By using an historical or a cultural context, students can broaden their understanding of where design inspirations can come from. This approach broadens understanding about the importance of experimenting with creative ideas, daring to be different and the way designers gain inspiration from designs of the past to create something new.

In this unit students use primary sources of information gained from conducting surveys, carrying out tests and taking photographs. They also make use of gathered secondary resources from existing published information collated by others available from the Internet and print media.

Example activities

AREA OF STUDY 1: Designing within a team

Outcome 1

Design and plan a product, a product range or a group product with component parts in response to a design brief based on a common theme, both individually and within a team.

Examples of learning activities

working as part of a design team, use a teacher developed design brief (including constraints and considerations) to identify and label relevant Product design factors and parameters; each group nominates a spokesperson to explain how the design brief incorporates human-centred design factors

Teacher moderates a class blog to:

- identify a design need
- identify a design theme
- decide on an historical and/or a cultural design movement or style for inspiration

Students working in a design team:

- agree on a scenario based around a theme
- decide on an historical and/or a cultural design movement or style to provide inspiration
- decide if the team will make a product range or a group product with component parts
- generate a design brief that incorporates
  - the agreed theme
  - historical and/or cultural design movement or style
  - relevant Product design factors and consideration of human factors (ergonomics) design
- delegate individual roles and responsibilities and decide whether it is necessary to develop their own individual design briefs
- individually, students write individual briefs if required

referring to their design brief, students write evaluation criteria in question form, justify each criterion and outline a checking method to determine if and how each criterion has been met

discuss with the class methods of evaluating individual contributions to the team during design, planning and production

provide an overview of the main historical and cultural design movements and styles using a multimedia presentation; in teams, collaboratively choose one movement or style; prepare and present a multimedia presentation to explain key design elements to inspire the team's product design

visit the National Gallery of Victoria or a local gallery to look at how historical and cultural design movements or styles have influenced or could inspire new product designs

referring to an artefact in a gallery explain how design principles and elements evident in the product could be used in another product

research and discuss within their design teams, methods of using ICT to support collaboration in the product design process within a global environment; present a written or an oral report to the class of their findings, including the advantages and disadvantages of collaboration using ICT

the ICT teacher visits the class to discuss the social protocols and tools and techniques for working collaboratively online

individually research and discuss either social, economic, or environmental issues of sustainability related to design; environmental issues could include research into the materials that the group's product or products will be made from and should inform the justification of the materials

present design research and ideas using a range of different methods including image/mood boards, material and product samples, diagrams, charts and materials property testing relevant to their team's product or products

access the Design process part of the Design Awareness in Schools resource on the VELS website: <http://vels.vcaa.vic.edu.au/support/dais/process.html> and use creative techniques from TRIZ or SCAMPER to generate design ideas; critique and annotate design ideas in relation to the design brief

in design teams, students:

- refer to the Product design process diagram
- develop concept sketch visualisations
- develop three or four design options (presentation drawings)
- select and justify the preferred option
- develop a working drawing

use ICT and CAD as appropriate to communicate assembly, exploded views and design detail

present their design and development work to their design team and invite critical and constructive feedback and suggestions for modifications if necessary

write justifications of the preferred design option using feedback from team members with reference to the design brief constraints and considerations

access Materials Safety Data sheets relevant to their products and discuss with the teacher any precautions and safety measures required to eliminate safety hazards

devise a production plan from the working drawing/s showing a sequence of production steps; include estimated time needed for each step; tools, equipment and machines to be used; relevant risk assessment; quality measures/checks and leave room to fill in modifications to the plan

refer to relevant resources such as catalogues to compile a materials/components list and their purchase price

Detailed example

INVESTIGATION OF AN HISTORICAL AND/OR A CULTURAL DESIGN MOVEMENT TO INSPIRE PRODUCT DESIGN

The teacher prepares a multimedia presentation that provides an overview of the main historical and/or cultural design movements or styles. These include but are not restricted to Bauhaus, Art Deco, Memphis, Minimalism, Organic Design Style, oriental, Gothic, music genres and fashion houses.

Discuss with students the key characteristics of products produced by designer/makers from the movements or styles, for example Bauhaus: rejection of ornamentation in favour of functionality; asymmetry and regularity versus symmetry; form follows function.

Incorporate the Product design factors in the discussion, in particular the visual, tactile and aesthetic design principles and elements.

In design teams, students:

- collaboratively choose one movement or style;
- prepare and present a multimedia presentation of the selected movement or style explaining the design principles and elements that appeal to the team and how they could inspire the design of their product/s.

As an example, the Powerhouse Museum website has a range of chairs that span several historical movements.

AREA OF STUDY 2: Producing and evaluating a collaboratively designed product

Outcome 2

Justify, manage and use appropriate production processes to safely make a product and evaluate, individually and as a member of a team, the processes and materials used, and the suitability of a product or components of a group product against the design brief.

Examples of learning activities

demonstrate safe production techniques using tools, equipment, machines and materials to make the specified product and discuss with the teacher how they are following their production plans

analyse each production process for potential risks and use a multimedia presentation to outline the safe handling/use of tools, machinery, equipment, materials and chemicals involved in making the product

produce a record of progress/logbook using digital images and an explanation of each stage; modifications should be included

use the previously established evaluation criteria to evaluate the group's product/s as a solution to the design brief including:

- whether the product meets the requirements outlined in the design brief
- how the historical and/or cultural movement or style influenced and enhanced the design
- the degree to which human-centred design factors and social, economic and environmental factors were considered in the design

suggest improvements using feedback from others

complete an evaluation of teams' effectiveness in planning, and efficiency in design and production activities including:

- the success of the teams' collaboration and the individual's contributions/ productivity
- effectiveness and usefulness of working drawings
- the usefulness and success of the production plan when compared to the record of progress
- suitability of production processes
- effective use of time
- suggestions for improvements

Detailed example

RECORD OF PROGRESS

Discuss with the class the purpose of recording the production progress. This could include:

- to record progress, including digital images of key stages of production
- to outline progress and what has to be done next
- to note modifications and reasons for falling behind the proposed timeline
- to record the production processes/activities, and modifications for accurate evaluation of the planning and production activities
- to provide evidence of the safe use of tools, equipment and materials through photographs of personal protective equipment (PPE) use etc for risk management.

While students work, encourage them to digitally record their production activities, safe use of tools, equipment and machines.

Provide class time for students to download digital images and write entries in their logbook.

Students note reasons for modifications, referring back to their production plan. They comment on their efficient use of time, what delays they experienced and why.

Students submit the completed logbook with the completed team product/s.

Unit 3: Applying the Product design process

In Unit 3 Outcome 1, the teacher provides an actual or a hypothetical scenario that students use to develop a design brief. For example, a scenario could be based on a homewares shop at a beach resort that needs furniture and clothing designs to sell to holiday makers and people who have holiday homes in the area.

For Outcome 2, students learn about product development in industry. Students will build on their knowledge of sustainable design with a focus on industry. RMIT's Centre for Design is an excellent resource <www.rmit.edu.au/CFD> for information on Life Cycle Analysis/Assessment and other tools used to assess the environmental impacts of design. The Design Victoria site also has information on Eco-design for Designers.

In Unit 3, Outcome 3 the student takes on the role of a designer and uses the Product design process when designing and making a product. Outcome 3 has a clear link with Unit 4, Outcomes 2 and 3. The importance of linking the Product design factors back to the design brief must be emphasised; annotations on the design brief could be used for this purpose. During the conceptualisation stage students must acknowledge IP and sources of information used in research and for inspiration.

In Unit 3, Outcome 3 students develop a decision matrix to assist in the selection and justification of the preferred design option. A decision matrix is a methodical way for a student/designer to evaluate the different design options by prioritising and assigning weighting to the most important considerations and constraints in the design brief. These generally relate to the client's and/or end-user's needs and wants. In this way the choice of design option can be mathematically narrowed down to one.

When a decision matrix is used the results can also be used to improve a design option. A design option might be weighted high for functionality and ergonomics but low for suiting the client's and/or end user's taste. The design option can then be modified to better suit the client and/or end user.

Two sample design matrices are shown below.

Sample 1

Design Option 1 – Percentage rating method

Constraint in question form	Weighting allocated (0%–100%)	Rating of this design
How functional is the product?	30	20
How well have ergonomics and comfort been included in the product design?	25	20
How well does the design of the product suit the client's tastes?	20	5
Are the materials proposed the most appropriate for the product?	15	10
How well do the colours suit the client?	10	10
Total		65%

Sample 2

Design Option 1 – Weighting 1–5 scale: 1 = poor, 5 = excellent

Constraint in question form	1	2	3	4	5
How functional is the product ?			3		
How well have ergonomics and comfort been included in the product design?					5
How well does the design of the product suit the client's tastes?	1				
Are the materials proposed the most appropriate for the product?			3		
How well do the colours suit the client?			3		
Total 15/25	1		9		5

Example activities

AREA OF STUDY 1: The designer, client and/or end-user in product development

Outcome 1

Explain the roles of the designer, client and/or end-users, the Product design process and its initial stages, including investigating and defining a design problem, and explain how the design process leads to product design development.

Examples of learning activities

using an electronic whiteboard, class members take turns in putting the stages and steps of the Product design process in the correct order

divide the class into four groups and assign each group a stage of the Product design process; each group, in sequence, explains the steps, links between and purpose of each step; and what the goals of each stage are and how this relates to their future work

using an electronic whiteboard, class members match the Product design factors with their related parameters; give a team of two students a photo of a product and ask each group to explain which Product design factors would need to have been considered by the designer of their product

assign groups of students one of the factors from the Product design factors table; each group selects three products and explains to the class how the designer of their products would need to have considered the relevant factor/relevant parameters

complete a flow chart to explain how a commonly used product or a product from the Top Designs exhibition could have been developed using the Product design process; explain the role of the designer in the Product design process

give teams of students a range of representations of design processes and ask them to explain the similarities and differences to the VCE Product design process

visit a designer or invite a designer to speak about their work and how they establish and respond to the client's/end-users' needs and requirements, particularly in relation to the function and appeal of a product

bring a product to class (e.g. a backpack) and ask students to write the design brief that could have been used for the design of this product

provide a design brief; ask students to annotate the following on the brief:

- context/situation
- considerations
- constraints
- any parameters identified from the Product design factors

students electronically annotate a design brief to show they understand where (in the brief) the need, considerations and constraints are located

using a teacher provided design brief, students discuss key research questions a designer would need to ask to find out relevant information before developing design ideas and options

conduct a class discussion on how designers use market research to establish a need or client requirements

as a class develop a concept map to show information that a designer would need to collect about a design situation or context

watch and discuss video/vodcast case studies about how a designer collects, records and develops relevant research about a design problem; discuss how the needs and requirements of the client and/or end-user/s are determined and written into the design brief; refer to the Product design factors in discussions

using a teacher provided design brief, students practise writing four-part evaluation criteria

discuss the role of designers and how they use market research to establish a need or client requirements; produce a graphic organiser to show information that a designer would need to collect about a specific design situation

Detailed example

HOW A DESIGNER COLLECTS, RECORDS AND DEVELOPS RELEVANT INFORMATION ABOUT THE DESIGN PROBLEM

Provide students with a two-column table. In the left column the Product design factors are listed. The right column is left blank.

Discuss with the class each of the Product design factors and how they could influence the designer when they are designing a product.

As a class watch a video/vodcast of a case study of a product design process. Ask students to note:

- the different methods a designer uses to collect and record information that is relevant to the design problem.
- how the designer establishes the needs and requirements of the client and/or end-user/s so that they meet the requirements of a design brief.

Students fill in the blank parameters section of the table, alongside the relevant Product design factors and discuss why they included that information and how it could help to write a design brief.

AREA OF STUDY 2: Product development in industry

Outcome 2	***Examples of learning activities***
Explain and analyse influences on the design, development and manufacture of products within industrial settings.	access the Australian Bureau of Statistics website to identify the different manufacturing sectors; research the role of the main manufacturing industries research and report on one manufacturing industry that produces products at low volume and another high volume continuous system producer; use text and images to explain the differences visit a business/manufacturer to determine what market research methods the company uses; investigate the role and importance of research and development (R&D) and how the manufacturing industry briefs designers to innovate through creative design approaches use case studies such as the Materia website to research the importance of new technologies, materials and process and the influence these have on product design and manufacture research and prepare a report on an organisation such as the CSIRO to determine recent research projects and how this research is used by manufacturing companies discuss a video/vodcast that demonstrates the design and production of a product/s and how design is integral to the product development process in this industrial setting find examples of companies that encourage prosumerism and discuss the benefits and drawbacks of consumers directly participating in the product development process via Web 2.0 and other new technologies use a visual organiser to compare the Product design process with the stages used by a design and manufacturing company compare and contrast incremental, pioneer and blue sky product design innovation and describe the benefits to companies and consumers of these types of innovation discuss in class the following statement 'New and emerging technologies, materials and processes significantly influence product design'; include in the discussion laser technology and robotics; Computer-aided design (CAD), computer-aided manufacture (CAM); computer numerical control (CNC) and rapid 3-d prototyping use the Internet to research the reasons for and benefits of lean and Just-in-Time manufacturing use the Internet to research how international and Australian Standards such as ISO 9000 effect or influence safety, consistency and quality of operations and products companies produce; share and discuss the examples and provide notes that explain the benefits or importance of complying with these standards prepare a short tutorial on the way market research and evaluation affected a product design and its production and marketing; explain the role of market research and evaluation in the development of the product

diagrammatically represent how products are developed in industry; include the people involved in the design, development and marketing of the manufactured products

using the Australia innovates or a century of design on the Powerhouse Museum, Sydney website, select a product for teams of students to research and report back to the class with reference to the Product design factors; the research must cover the design, manufacture and marketing of the product and how social, legal, environmental, economic, technological and time factors affect production

use two newspaper or magazine advertisements to annotate the Five Ps of marketing

conduct a class discussion on the manufacturing methods that improve sustainability outcomes and influence consumer choices

access the WorkSafe Victoria or Safe Work Australia advertisements or website and discuss key messages about workplace safety; access evidence of workplace accidents and discuss the likely consequences; discuss the social reasons for the OH&S legislation

referring to products that still work but are superseded or obsolete such as a Gameboy or mobile phone, discuss the differences between style, technical and functional obsolescence and implications for the producer and consumer; choose another product and explain using text and images how the product could or has become obsolete

students research different scales of manufacturing systems such as one-off, low-volume (batch) and continuous volume (mass) production; investigate how a product is manufactured and explain why this method is suitable

Detailed example

ANNOTATING THE FIVE Ps OF MARKETING USING ADVERTISEMENTS

The teacher identifies the Five Ps of marketing (or marketing mix).

As a class, students discuss why people, product, place, promotion and price need to be considered when marketing a product.

Students conduct an Internet search for more information by entering ‘Define: Marketing mix’ or ‘Five Ps of marketing’.

Students select two advertisements from newspapers or magazines.

For each advertisement students describe:

- the target group
- product features such as function, appearance, warranty, highlighted in the advertisement
- the place of purchase
- the type of promotion and the likely reason the advertisement was placed on that particular page or in that specific newspaper or magazine
- the price of the product and why it has that pricing.

AREA OF STUDY 3: Designing for others

Outcome 3

Present a folio that documents the Product design process used while working as a designer to meet the needs of a client and/or an end-user, and commence production of the designed product

Examples of learning activities

in small groups discuss the Product design process and how it enables and impacts on the development of a quality product for a client and/or an end-user

annotate the Product design process to show understanding of the intended outcomes of each stage and step

brainstorm methods of researching, collecting, analysing and presenting information that could be used to determine the needs of a client and/or an end-user

after identifying a client and/or an end-user, highlight and explain which Product design factors are relevant to their needs and requirements

based on a client and/or an end-user interview, each student writes a profile to outline their design tastes and lifestyles and other relevant information

students develop a design brief to outline an identified design context to establish the needs and requirements of the client and/or an end-user in the constraints and considerations; refer to relevant Product design factors in the design brief

collect and document appropriate information about the client and/or an end-user and existing solutions to similar design problems using a range of sources, including books, magazines and the Internet to assist with ideas that could address the requirements in the design brief

the teacher demonstrates and explains how to develop four-part evaluation criteria from a given design brief; using the same brief, students then develop a further two sets of four-part evaluation criteria from the design brief, considerations and constraints

the class brainstorms different methods to research and test the properties and characteristics of materials, fixtures, fittings and fastenings

investigate how designers can gather relevant information about processes (construction or decorative methods), ergonomics and design inspirations that could be suitable and appropriate for a product design; produce a poster of findings, acknowledging all sources of information

test a property of a material and document the test and results; provide recommendations for the suitability of the material for a particular product

watch a multimedia presentation that documents how a designer uses different creative and critical design thinking techniques and resolves and communicates design ideas

keep a sketch book to record design ideas and inspirations during and outside class

practise a range of freehand drawing methods using a range of media (pencil, pens, markers, wash)

develop four to six design options, a preferred option and working drawings of the preferred option using appropriate drawing techniques and terminology; use appropriate ICT software tools and functions

discuss with students how to appropriately annotate drawings to communicate product specifications that relate to the considerations and constraints in the design brief

in consultation with the client and/or end user, complete a decision matrix/client selection grid that has links to the considerations and constraints in the design brief; write a justification of the preferred option with reference to the decision matrix

examine the role of a production plan in product design and manufacture; complete a production plan that shows the processes, materials, tools, equipment and machines to be used, and estimate the time to complete each task; include a risk assessment for the use of equipment and materials and quality measures/quality checks in the production plan

access and download a Control of OH&S Hazards and Risks chart for a pedestal drill, disc sander or other fixed machines that are permitted for student use and refer to the chart during production

complete a materials and costing list that includes fixtures, fittings (hardware), fastenings (notions) for the product to be made

analyse the design and production processes to make the product and keep a record of reflections on the efficiency and effectiveness demonstrated during production

record progress of the production activities using digital images and text; digitally record quality measures/checks and modifications to the original design

Detailed example

DECISION-MAKING MATRIX AND JUSTIFICATION OF PREFERRED OPTION

Students are instructed to:

- search the Internet for information on 'decision-making matrix' and read about them as well as view the images
- choose a matrix design/layout that best suits their needs
- meet with their client or get end-user feedback in relation to the importance of/ranking of the evaluation criteria that was previously established
- prioritise the top 4 to 5 evaluation criteria in consultation with the client or an end-user.

A matrix or grid is drawn up to provide client or end-user feedback for each design option so that the best combination of desirable design features can be judged to meet the constraints and consideration in the design brief.

The student completes the matrix in conjunction with the client and/or end-user to enable a decision to be made as to which design option best suits the requirements. Using this information, the student writes a short justification of the preferred option referring to the decision matrix and relating the information back to the design brief.

Unit 4: Product development and evaluation

Unit 4, Outcome 1 includes references to qualitative and quantitative methods of evaluating products. A very useful reference for this part of the outcome is the Choice website: <www.choice.com.au/> that provides reviews for consumers of a range of products.

Values attributed to products and how these vary over the life of a product and between designers, manufacturers and users/owners is introduced in Unit 4, Outcome 1. This is best addressed by referring to products students are familiar with.

Unit 4, Outcome 3 deals with the final evaluation stage of the Product design process. Students highlight their product's design features to the client and/or end user. Researching and outlining care requirements informs the user about how to adequately care for the product to ensure it remains in good condition. The care label should reflect students' understanding of the properties and characteristics of the materials researched in Unit 3, Outcome 3.

Example activities

AREA OF STUDY 1: Product analysis and comparison

Outcome 1	***Examples of learning activities***
Compare, analyse and evaluate similar commercial products, taking into account a range of factors and using appropriate techniques.	the teacher provides three different products that have the same primary function; students develop a set of evaluation criteria and a decision matrix based on qualitative and quantative methods to compare the function/performance, ease of use, reliability, durability, aesthetics, safety and suitability of materials; present the findings to the class
	using *Choice* magazine, read an article on testing a product of interest; analyse the information, summarise the criteria used to compare the products and explain why one product is better than the others
	watch a multimedia production related to the social and environmental issues associated with products such as 'Environmental, social and economic issues in Textiles' or 'Tropical timber trade' and discuss the positive and negative social and environmental issues that could be of concern to purchases/users
	browse the Internet for articles that raise social and environmental concerns about products; list the concerns and benefits for potential purchasers/users
	students bring to class one product that they each value and explain why; reasons are listed on the whiteboard then added to
	role-play a designer, manufacturer and user/owner of a product; discuss the different values each may attribute to a particular product
	provide photos or a slide show of three different products that all have the same primary function; for example, a desk to work at, a pen to write with, a cup to drink from; list the values and discuss the different values attributed to products by designers, manufacturers and users/owners and why they vary
	using *Choice* magazine articles on testing products, determine what key factors contribute to the quality of a product

Detailed example

ENVIRONMENTAL AND SOCIAL ISSUES ASSOCIATED WITH PRODUCTS

Students discuss products that raise environmental and social concerns in the news or generally within the community. For example, light bulbs – energy efficient versus incandescent, or cars – hybrid versus petrol.

The key concerns are written down such as green house gas emissions, land degradation, loss of habitat, loss of jobs, medical issues, dumping of waste in third world countries and so on.

Students draw up a table to document the environmental and social concerns and benefits.

Students summarise the results and analyse how this has affected potential purchasers/users and subsequently the impact on the product's design viability.

AREA OF STUDY 2: Product manufacture

Outcome 2

Safely apply a range of production skills and processes to make the product designed in Unit 3, and manage time and resources effectively and efficiently.

Examples of learning activities

download photos of the tools and equipment to be used, annotate photos to explain what the tool is, how it will be used on the product and any associated risks and how these risks can be minimised or eliminated

download a Control of OH&S Hazards and Risk sheet from the WorkSafe Victoria website; complete the form for a pedestal drill, disc sander or other fixed machines that students are permitted to use during production of the project

download a relevant Material Safety Data Sheet (MSDS) and discuss the 'classified as hazardous' and health information on the sheet; highlight and annotate the key information

during production, record progress in a digital logbook showing the correct use of tools and equipment, quality measures/checks and use of personal protective equipment (PPE) and other safety management requirements; use digital images and text to document progress

record in the production plan or logbook any modifications or time management variations

record in the client consultation log, agreed modifications from the client and/or end-user and feedback on the production progress

Detailed example

RISK ASSESSMENT

Download a Control of OH&S Hazards and Risks sheet from the *Controlling OH&S hazards and risks: A Handbook for workplaces* handbook from the WorkSafe Victoria website and Plant Risk Assessment sheets for specific equipment.

The teacher explains to students the meaning of each of the sections in the Plant Risk Assessment.

The teacher discusses the hazards, and how the liklihood of harm can be determined. Control measures are also discussed.

Each student completes a Plant Risk Assessment for machines they will use in their production work; for example, a pedestal drill, disc sander or other fixed machines that students are permitted to use.

AREA OF STUDY 3: Product evaluation

Outcome 3

Evaluate the outcomes of the design, planning and production activities, explain the product's design features to the client and/or an end-user and outline its care requirements.

Examples of learning activities

interview and record client and/or end-user feedback to gather information for evaluation criteria for the completed product

complete the testing methods suggested in the four-part evaluation criteria developed earlier, and record results using digital images and text

refer back to the logbook, production plan and working drawings to complete the evaluation criteria for the design and production activities

reflect on the design and production activities and discuss with the client and/or an end-user or others, methods to improve future products; record the information in the final evaluation

photograph or develop a CAD of the finished product, the key design features and the main functions; annotate the image, drawing attention to these unique features and the finished quality; show the client and/or an end-user and ask for their feedback; complete a care label or instructions that outline how to care for and maintain the product in good condition to prolong the product's life and appearance

Detailed example

MULTIMEDIA PRESENTATION OF PRODUCT'S FEATURES AND CARE REQUIREMENTS

Students photograph their finished product or develop a computer-aided drawing (CAD) of it. The important design features and main functions must be photographed.

Compile a slide show or an A3 presentation of the annotated photographs/CAD that showcases the unique design features, functions and the finished quality.

The multimedia presentation shows all aspects of the product that could impress the client and/or an end-user and demonstrates that the needs and requirements have been met. Show the client and/or end-user and record the feedback.

Students then research care labels/swing tags or instructions for safe use and maintenance of products. They record the information from different labels/instructions and discuss what needs to be on these labels to ensure a product is well maintained and hence lasts longer in good condition.

Students complete a care label/swing tag or instructions that outline the main care requirements to maintain the product in good condition to prolong its life, appearance and function.

Information for the care label/swing tag could include what to use to clean or care for the product, how to repair any damage, additional fittings or notions or where to purchase these items.

SCHOOL-ASSESSED COURSEWORK

In Units 3 and 4 teachers must select appropriate tasks from the assessment table provided for each unit. Advice on the assessment tasks and performance descriptors to assist teachers in designing and marking assessment tasks will be published online by the Victorian Curriculum and Assessment Authority in an assessment handbook. The following is an example of a teacher's assessment program using a selection of the tasks from the Units 3 and 4 assessment tables.

Outcomes	Marks allocated	Assessment tasks
Unit 3 **Outcome 1** Explain the roles of the designer, client and/or end-user/s, the Product design process and its initial stages, including investigating and defining a design problem, and explain how the design process leads to product design development.	25	An annotated design brief developed from a scenario (provided by the teacher) which includes the context, constraints and considerations. Using a copy of the Product design factors as a reference point, any factors addressed in the brief are highlighted and explained. A copy of the Product design process is annotated, demonstrating how it links, at the different stages, to the design brief. Four-part evaluation criteria are developed with explanation of why they are important, how they can be achieved during design and production and how these criteria can be tested or checked on the finished product. A concept map to show types and methods of collecting relevant research. Outline of drawings the designer would develop.
Outcome 2 Explain and analyse influences on the design, development and manufacture of products within industrial settings.	35	A short written report/case study of a specific industry explaining how companies react to market demands and technological developments. The suitability of the manufacturing system used is compared to other systems such as one-off, low-volume or continuous (volume). Defining the role of research and development (R&D) and market research including the Five Ps of marketing, related to the product development process. Demonstrate an understanding of obsolescence and sustainability systems and models in that industry such as Design for the Environment or Life Cycle Analysis.
Total marks for Unit 3	**60**	
Unit 4 **Outcome 1** Compare, analyse and evaluate similar commercial products, taking into account a range of factors and using appropriate techniques.	40	A multimedia report that analyses and compares commercially produced products that have a similar purpose. Qualitative and quantative methods of evaluation are used to establish the relevant Product design factors and explain how attributes of products are prioritised. Comparisons are made and recommendations provided with reasons for decisions, with reference to quality.
Total marks for Unit 4	**40**	

SCHOOL-ASSESSED TASK

In Units 3 and 4 teachers must provide students with the opportunities to complete the School-assessed Task. The following is an example of a teacher's assessment program based on the tasks from the Units 3 and 4 assessment tables.

Outcomes	Components of School-assessed Task
Unit 3 **Outcome 3** Present a folio that documents the Product design process used while working as a designer to meet the needs of a client and/or an end-user, and commence production of the designed product.	A design folio that includes a profile of the client and/or an end-user, design brief, with reference to Product design factors, quality statement, constraints and considerations, four-part evaluation criteria including design and production processes, research linked back to the brief, visualisations/sketches/drawings/CAD, with annotations, decision matrices/weighted criteria for each design option and client feedback. Justification of preferred option, prototype/toile, working drawings using conventions, product specifications, cutting and costing list, production plan with quality checks/measures and modifications, Gantt chart, safety information and risk assessments, materials testing, tools and equipment to be used. Acknowledgement of IP and copyright.
Unit 4 **Outcome 2** Safely apply a range of production skills and processes to make the product designed in Unit 3, and manage time and resources effectively and efficiently.	Production work demonstrating safe use of materials, tools and processes, accompanied by a logbook/record of progress including photographs and documentation of quality checks/measures and modifications to the preferred option. Use of ICT where appropriate. Completed functional product that includes some processes with a degree of difficulty. The product complies with the statement of quality and the client's needs and wants.
Outcome 3 Evaluate the outcomes of the design, planning and production activities, explain the product's design features to the client and/or an end-user and outline its care requirements.	An evaluation report using client or end-user feedback, the four-part evaluation criteria to examine the effectiveness and efficiency of the design, planning and production activities. Evaluation indicates future improvements that could be made for design, planning and production activities. An annotated image (photo, ICT drawn picture or sketch) that highlights the main features of the product and includes a care label with instructions on how to care for the product to ensure it is well maintained.