Accreditation Period
2018–2023

Victorian Certificate of Education

PRODUCT DESIGN AND TECHNOLOGY

STUDY DESIGN

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VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

VICTORIA State Government

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Contents

Important information

Accreditation period

Units 1–4: 1 January 2018 – 31 December 2023

Implementation of this study commences in 2018.

Other sources of information

The *VCAA Bulletin* 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 VCAA's website at: www.vcaa.vic.edu.au.

To assist teachers in developing courses, the VCAA publishes online the *Advice for teachers*, which includes teaching and learning activities for Units 1–4, and advice on assessment tasks and performance level descriptors for School-assessed Coursework in Units 3 and 4.

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.

Copyright

Introduction

Scope of study

Product design is a response to changing needs and to improve quality of life by designing creative, innovative and sustainable products. Product design is enhanced through knowledge of social, technological, economic, historical, ethical, legal, environmental and cultural factors. These factors influence the aesthetics, form and function of products.

Central to VCE Product Design and Technology is design thinking, which is applied through the product design process providing a structure for creative problem solving. The design process involves identification of a real need, problem or opportunity that is then articulated in a design brief. The need, problem or opportunity is investigated and informed by research to aid the development of solutions that take the form of physical, three-dimensional products. Development of these solutions requires the application of technology and a variety of cognitive and physical skills, including design thinking, drawing and computer-aided design, testing processes and materials, planning, construction, fabrication and evaluation.

For VCE Product Design and Technology students assume the role of a designer-maker. In adopting this role, they develop and apply knowledge of factors that influence design and 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 safely transform these materials into products. Increasingly, the importance of sustainability is affecting product design and development, and so is at the forefront throughout the product's life cycle.

Rationale

Designers play an important part in our daily lives. They determine the form and function of the products we use and transform ideas into drawings and plans for the creation of products that fulfil human needs and wants. Students also consider sustainability issues.

Students consider the consequences of product design choices, and develop skills to critically analyse existing products and develop their own creative solutions.

VCE Product Design and Technology offers students a range of career pathways in design in fields such as industrial, transport, service, interior and exhibition, engineering, fashion, furniture, jewellery, textile and ceramics, at both professional and vocational levels. Moreover, VCE Product Design and Technology informs sustainable behaviours and develops technical skills enabling students to present multiple solutions to everyday life situations. It contributes to developing creative problem solvers and project managers well-equipped to deal with the multi-disciplinary nature of modern workplaces.

Aims

This study enables students to:

- use design thinking and develop their understanding of product development and how these occur in a variety of contexts and environments
- apply design practice by generating and communicating 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, producing and assembling materials and social, economic, ethical, legal and environmental implications
- use risk assessment to apply appropriate, efficient and safe methods of working with materials, tools, equipment and machines
- apply project management techniques of time and sequence, and choose appropriate processes
- analyse and evaluate the appropriateness of production activities and product design
- understand sustainability and the responsibility the designer has to address social, environmental and economic considerations when designing and creating for the needs of the broader community.

Structure

The study is made up of four units.

Unit 1: Sustainable product redevelopment

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.

Cross-study specifications applicable to Units 1 to 4 are included on pages 9–12.

Entry

There are no prerequisites for entry to Units 1, 2 and 3. Students must undertake Unit 3 and Unit 4 as a sequence. 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.* The Bulletin 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 Bulletin.

Monitoring for quality

As part of ongoing monitoring and quality assurance, the VCAA 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

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.

This study may involve the handling of potentially hazardous substances and the use of potentially hazardous equipment. Teachers should refer to the Hazards substances information within the OHS Management System on the Department of Education and Training's Chemical Management page and also Use of machinery in technology teaching.

For additional information about risk assessment, refer to the WorkSafe website.

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 21820VIC Course in Safe Use of Machinery for Technology Teaching (Woodwork and Metalwork).

Details about types of appropriate equipment for use in this study are included in the *Advice for teachers*.

Employability skills

This study offers a number of opportunities for students to develop employability skills. The *Advice for teachers* 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 *Privacy and Data Protection Act 2014* 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 the teacher's decision that the student has demonstrated achievement of the set of outcomes specified for the unit. Demonstration of achievement of outcomes and satisfactory completion of a unit are determined by evidence gained through the assessment of a range of learning activities and tasks.

Teachers must develop courses that provide appropriate opportunities for students to demonstrate satisfactory achievement of outcomes.

The decision about satisfactory completion of a unit is distinct from the assessment of levels of achievement. Schools will report a student's result for each unit to the VCAA as S (Satisfactory) or N (Not Satisfactory).

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 VCAA. Schools may choose to report levels of achievement using grades, descriptive statements or other indicators.

Units 3 and 4

The VCAA specifies the assessment procedures for students undertaking scored assessment in Units 3 and 4. Designated assessment tasks are provided in the details for each unit in VCE study designs.

The student's level of achievement in Units 3 and 4 will be determined by School-assessed Coursework (SACs) and a School-assessed Task (SAT) as specified in the VCE study design, and external assessment.

The VCAA will report the student's level of achievement on each assessment component as a grade from A+ to E or UG (ungraded). To receive a study score the student 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:

- Units 3 and 4 School-assessed Coursework: 20 per cent
- Units 3 and 4 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.

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.

Cross-study specifications

Cross-study specifications provide details of the concepts which underpin Units 1 to 4 of the study design. These concepts provide students with the methodology to achieve designed solutions. They should inform students' work, and should be applied to resolve each design problem systematically throughout the study.

Design brief

A design brief is developed to clarify the project task and to define the personal, local or global design problem to be solved. A design brief will typically identify intended end-user/s, constraints and considerations with reference to product design factors.

Product design process

The product design process is the application of design thinking that involves the use of strategies for understanding design needs and opportunities, visualising and generating creative and innovative ideas, planning, and analysing and evaluating the ideas that best meet the criteria. The use of creative and critical thinking techniques enables students to develop, articulate, analyse and reflect on the product design process. Consideration of economic, environmental and social impacts that result from designed solutions are core to design thinking and the product design process.

The product design process has four stages:

- Investigating and defining
- Design and development (conceptualisation)
- Planning and production
- Evaluation.

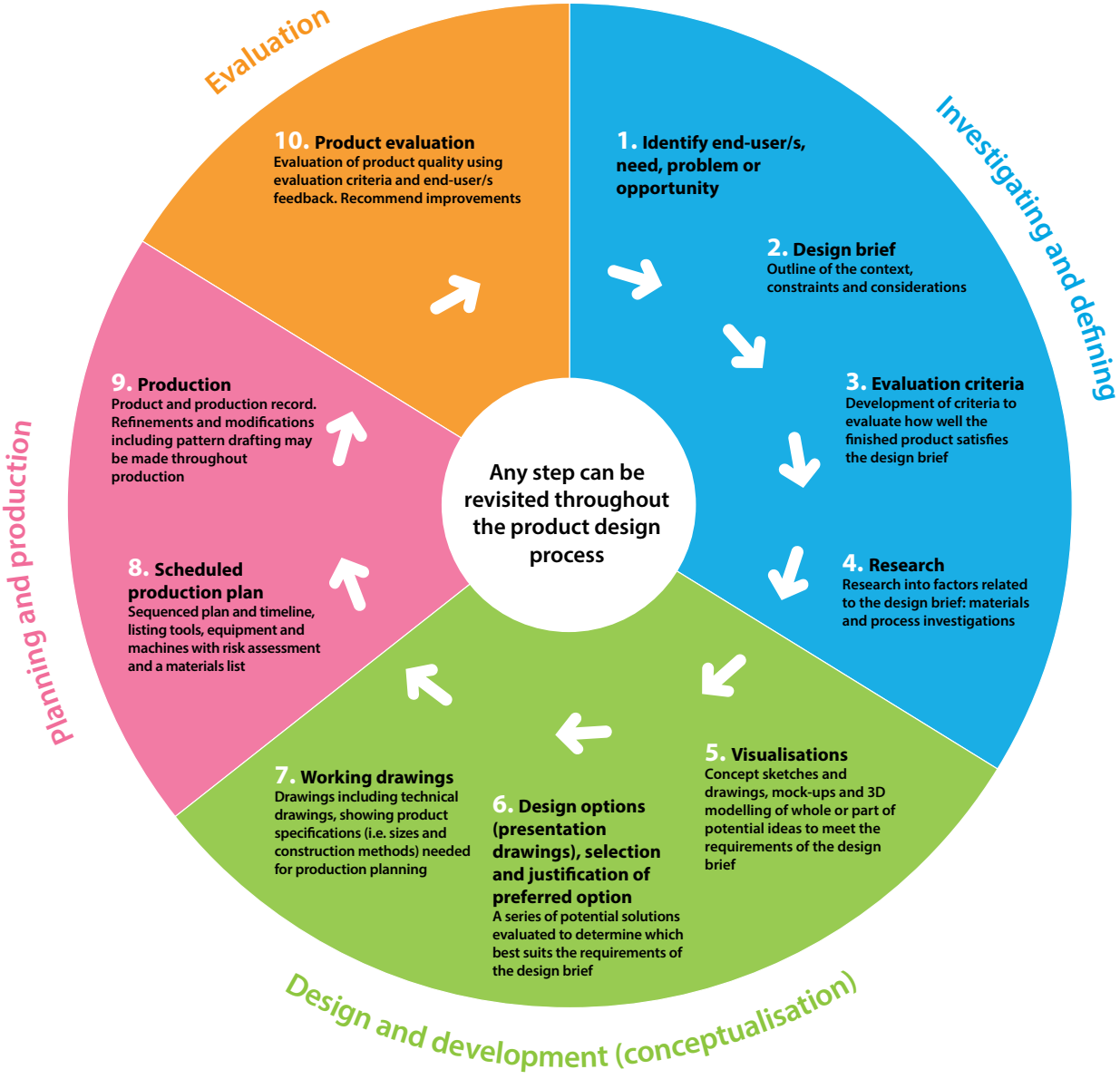
Each stage consists of a series of steps in the design and development of a product. The product design process is non-linear; that is, previous stages can be revisited to facilitate an interface between thinking and making to enable further visualisation of ideas, and formulation and enactment of procedures. The process should be adapted and customised to suit each project. Depending on the context, some steps may require more emphasis or feedback. The diagram on page 10 outlines the four stages and the steps within these stages.

Evaluation criteria

Throughout Units 1 to 4, students develop evaluation criteria from the design brief. These criteria are used to inform and justify the selected design option, and evaluate the success of the finished product in relation to solving the design problem for the end-user/s. Each criterion has four parts:

- a question
- justification and relevance to the design brief
- the process used to evaluate the success of the product
- how the finished product could be tested or checked.

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 influence the design of a product. Some will be included in a design brief and may also be used in product evaluation. In the following table, the factors have been placed into broad categories, with parameters overlapping and interconnecting, depending on the individual context.

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 function and secondary functions that support its use are considered.
User-centred design	End-user/s' problems or needs identified to improve wellbeing and/or quality of life. In response to these needs, considerations include culture and religion, age, economic status, emotional and sensory appeal, universal design, social and physical needs, fashion and trends. Safety, accessibility, comfort, ergonomics and anthropometric data should also be considered.
Innovation and creativity	Innovation requires a creative approach to develop new or improved solutions to unsolved problems and opportunities. This involves invention, improvement, modification, incremental progress, experimentation and pushing the boundaries. Opportunities are identified from research and development, end-user/s feedback, new ideas and knowledge, new materials and emerging technologies.
Visual, tactile and aesthetic (design elements and principles)	Relate to the product's form, appearance and feel. 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. Design principles of balance, contrast, repetition, movement/rhythm, pattern, proportion, asymmetry/symmetry, negative/positive space and surface qualities are used to combine and arrange the design elements.
Sustainability	Involves the connection and interaction between three pillars of sustainability: social, economic and environmental systems. Underpinning factors include: life cycle analysis/assessment (LCA) and life cycle thinking, emotional attachment, carbon footprints, fair trade, 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/s. 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 end-user/s.
Materials – characteristics and properties	Materials appropriate to this study are listed on page 12. 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 usable 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 products using a range of construction materials.

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. 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 restricted to these areas. The product should not include significant mechanical and/or electrical and control systems components. It should not be a food, an agricultural, a horticultural (plant or animal) or an information technology product. The purpose and/or 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 Casings for consumer electronic products (e.g. communication/computer hardware, home entertainment, personal grooming products, power tools, kitchen appliances, personal/medical aids and devices, wearable technology)
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)		

If appropriate, the finished product in all units may be a high-quality prototype that is constructed to exactly resemble the preferred option (allowing for design modifications where required). The prototype should also attempt to meet all of the evaluation criteria developed from the design brief. In this study, references to product includes prototype. Appropriate substitute materials and processes may be used to create structure, form or finish if the originally specified materials and processes are not available (for example, 3D printing replacing injection moulding or manual cutting of fabric replacing laser cutting). All products must be full scale. Non-functioning electrical systems or other technologies can be simulated to indicate placement and function.

Mockups are trial models, process trials or calico toiles that are suitable for development stages only. They can be made to a smaller scale and may not accurately reflect intended materials or finish.

Unit 1: Sustainable product redevelopment

This unit focuses on the analysis, modification and improvement of a product design with consideration of sustainability.

It is common for designers in Australia to use products from overseas as inspiration when redeveloping products for the domestic market. Sustainable redevelopment refers to designers and makers ensuring products serve social, economic and environmental needs. Generating economic growth for design and manufacturing in Australia can begin with redeveloping existing products so they have positive social and minimal environmental impact. In this unit students examine claims of sustainable practices by designers.

Students consider the sustainability of an existing product, such as the impact of sourcing materials, manufacture, distribution, use and likely disposal. They consider how a redeveloped product should attempt to solve a problem related to the original product. Where possible, materials and manufacturing processes used should be carefully selected to improve the overall sustainability of the redeveloped product.

In Area of Study 1 students consider the sustainability of an existing product and acknowledge the intellectual property (IP) rights of the original designer. Working drawings (also known as flats, trade sketches, assembly or technical drawings) are used to present the preferred design option.

In Area of Study 2, students produce a redeveloped product using tools, equipment, machines and materials, taking into account safety considerations. They compare their product with the original design and evaluate it against the needs and requirements outlined in their design brief.

Area of Study 1

Sustainable redevelopment of a product

This area of study introduces students to the product design process, lifecycle analysis/assessment (LCA), IP and the product design factors, with an emphasis on sustainability. Students consider contemporary practices of designers who claim to incorporate sustainable practices.

Students investigate and consider how a product could be sustainably redeveloped. They write a design brief for the redevelopment of a product, improving the purpose and/or function and sustainability of the original product. Students develop criteria to evaluate design options and the finished product. Students also examine, test and trial the suitability of materials selected from the materials categories list on page 12. They gain an understanding of the characteristics and properties of materials that make them suitable and safe for specific products. They also examine the 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.

The redeveloped product must be significantly different from the original product. Prior to construction of the redeveloped product, students develop visualisations (concept sketches, drawings and/or mock-ups), presentation drawings of the design options and working drawings of their preferred option.

Referencing the working drawings, they compile a scheduled production plan, with a risk assessment and a list of materials. Students acknowledge IP of any design ideas that have been appropriated.

Outcome 1

On completion of this unit the student should be able to design and plan the redevelopment of a product with the intention of developing a different product with consideration of sustainability issues.

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

Key knowledge

- the environmental, economic and social impacts associated with the origin/source, manufacture, use and disposal of products
- approaches used by 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 product
- methods of incorporating relevant product design factors in a design brief
- methods of developing criteria for evaluating a finished product
- creative and critical design thinking techniques
- methods of generating, analysing and evaluating ideas for the redeveloped product
- the importance of acknowledging the IP rights of the designer of the product
- the role of annotations and appropriateness of different drawing techniques in the design and development stage of the product design process using digital and manual methods:
  - visualisations
  - presentation drawings
  - working drawings
- relevant material and process research methods such as tests, trials, comparisons and production process samples
- the role of scheduled production plans:
  - timeline
  - steps needed for production
  - materials and equipment list
  - risk management for safe, efficient and accurate production of a product
  - quality measures.

Key skills

- investigate practices of designers that address sustainability issues
- analyse the sustainability of an existing product
- develop a design brief for the modification and improvement of a product
- develop evaluation criteria for the finished product
- use the product design process
- appropriately acknowledge the IP of others
- develop and apply drawing skills for a range of purposes, using digital computer-aided design (CAD) and/or manual methods
- develop a scheduled production plan.

Area of Study 2

Producing and evaluating a redeveloped product

This area of study focuses on the implementation of the design and planning completed in Area of Study 1. Students refer to their working drawings and scheduled production plan, and apply a range of techniques and processes safely to make a redeveloped 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 methods used to critically analyse and evaluate their redeveloped products. They use criteria to compare the features of their redeveloped product with the original design, and evaluate the success of their design improvements including sustainability considerations.

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 select and apply materials, tools, equipment and processes to make a redeveloped product, and compare this with the original product.

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

Key knowledge

- tools, equipment and machines for specific purposes
- processes applicable to selected materials
- risk management for safe, accurate and efficient application of production processes using materials, tools, equipment and machines
- digital and manual techniques to manage and record production processes and progress
- methods of evaluating a redeveloped product to determine quality and suggest improvements
- the role of marking out, cutting, shaping, joining and finishing procedures used to determine appropriate, efficient and effective production processes to make a redeveloped product.

Key skills

- apply risk management in the production of the redeveloped product
- use materials, tools, equipment, machines and production processes to safely and accurately make a redeveloped product
- use marking out, cutting, shaping, joining, assembling, decorating and/or finishing processes to make a redeveloped product
- record progress and adjustments to the scheduled production plan
- respond to evaluation criteria
- evaluate the redeveloped product and suggest improvements.

Assessment

The award of satisfactory completion for a unit is based on whether the student has demonstrated the set of outcomes specified for the unit. Teachers should use a variety of learning activities and assessment tasks that provide a range of opportunities for students to demonstrate the key knowledge and key skills in the outcomes.

The areas of study, including the key knowledge and key skills listed for the outcomes, should be used for course design and the development of learning activities and assessment tasks. Assessment must be a part of the regular teaching and learning program and should be completed mainly in class and within a limited timeframe.

All assessments at Units 1 and 2 are school-based. Procedures for assessment of levels of achievement in Units 1 and 2 are a matter for school decision.

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

The two compulsory assessment tasks for this unit are:

- a design folio that contains an analysis of a product's sustainability, a design brief, evaluation criteria, research, visualisations and design options, working drawings, a scheduled production plan, and an evaluation report on the finished product
- a finished product and records of production and modifications.

Additionally, suitable tasks for assessment may be selected from the following:

- an oral presentation supported by notes and/or visual materials
- a short written report that includes materials testing or trialling activities, industry visits, technical reports
- a case study analysis.

Where teachers allow students to choose between tasks they must ensure that the tasks they set are of comparable scope and demand.

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 end-user/s' 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 use digital technologies to facilitate teams to work collaboratively online.

In this unit students gain inspiration from an historical or a contemporary 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 user-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 design style or movement. In Area of Study 2 the finished product is evaluated.

Area of Study 1

Designing within a team

This area of study enables students to apply the product design process collaboratively and individually. Each student works in a design team to generate one design brief collaboratively from a scenario, based around a theme and contributes to the design, planning and production of a group product. Individual roles and responsibilities are allocated. Students develop evaluation criteria for the finished product to determine if each criterion has been met through testing and feedback.

Students develop solutions that demonstrate an understanding of user-centred design factors. These factors constitute an area of design that analyses the interactions between product end-user/s and their made environment to maximise wellbeing and product performance. Students also consider other relevant product design factors. They use primary and secondary sources to research materials and processes needed to make the product and share their findings within the team.

Students investigate an historical or a contemporary design movement or style for inspiration. These movements or styles include but are not restricted to Bauhaus, Art Deco, Memphis, Minimalism, Organic Design Style, Biomorphism, Oriental and Gothic. Alternatively, students may investigate music genres, sub-cultures, technological themes, specific designers, brands, or 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 evaluation criteria. Students record their individual contribution to the team.

Students develop skills in both project management and presentation of their work, replicating processes used in the real world. Students also explore how digital technologies facilitate collaborative product design.

Outcome 1

On completion of this unit the student should be able to design and plan a product or range of products collaboratively in response to a design brief.

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

Key knowledge

- the role and application of the product design process to achieve a product within a collaborative environment
- user-centred design factors and how they influence the design of products
- historical and contemporary design movements, cultures or styles and how they can inspire new product designs
- economic, environmental and social issues of sustainability related to design
- critical and creative design thinking techniques
- the purpose of feedback to inform the selection and justification of viable design solutions
- methods of construction used to determine appropriate, efficient and effective production processes to make a product
- the role of scheduled production plans for collaborative work:
  - timeline
  - steps needed for production
  - materials and equipment list
  - risk management for safe, efficient and accurate production of a product
  - quality measures
  - estimated time needed for each step.

Key skills

- identify and allocate responsibilities within the team to conduct and share research
- investigate an historical or a contemporary cultural design movement or style
- research a design problem collaboratively using primary and secondary resources, and develop a design brief with relevant application of product design factors
- use digital technologies appropriately to support collaboration in the product design process
- present research and ideas using test reports, image/mood boards, material and product samples, diagrams, charts and/or drawings
- generate and select ideas using creative and critical design thinking techniques
- explain product functions and/or requirements, materials and construction methods using annotations in visualisations, design options and working drawings
- develop and use criteria, including those to evaluate product sustainability, and devise methods to check how the finished product will meet each criterion
- justify selection of materials based on their suitability and sustainability
- implement the design and development stage of the product design process using digital technologies, as appropriate
- provide critical and constructive feedback and justify preferred option selection
- devise a scheduled production plan with reference to working drawings.

Area of Study 2

Producing and evaluating within a team

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

Students use appropriate methods of recording production processes and discuss 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, checked and evaluated to determine how well each meets the requirements of the design brief. Students use criteria to evaluate the final product/s.

Outcome 2

On completion of this unit the student should be able to justify, manage and use appropriate production processes to make a product safely 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/s 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 make a product safely
- digital and manual methods of recording progress through production, including any modifications to the production plans
- methods to evaluate the suitability of the product or components of a group product/s as a solution to the design brief:
  - checking the product in relation to evaluation criteria
  - the extent to which the product was influenced by an historical or a contemporary cultural design movement or style with consideration of user-centred design factors and sustainability
  - observations and feedback from others
  - suggestions for improvements.

Key skills

- work individually and as a team member to make a product or components safely
- use risk management strategies 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 finished product or components to determine how they satisfy the design brief.

Assessment

The award of satisfactory completion for a unit is based on whether the student has demonstrated the set of outcomes specified for the unit. Teachers should use a variety of learning activities and assessment tasks that provide a range of opportunities for students to demonstrate the key knowledge and key skills in the outcomes.

The areas of study, including the key knowledge and key skills listed for the outcomes, should be used for course design and the development of learning activities and assessment tasks. Assessment must be a part of the regular teaching and learning program and should be completed mainly in class and within a limited timeframe.

All assessments at Units 1 and 2 are school-based. Procedures for assessment of levels of achievement in Units 1 and 2 are a matter for school decision.

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

The two compulsory assessment tasks for this unit are:

- a design folio that contains a design brief, evaluation criteria, research, visualisations and design options, working drawings, scheduled production plan, and evaluation report
- product and records of production and modifications

Additionally, suitable tasks for assessment may be selected from the following:

- an oral report supported by notes and/or visual materials
- a short written report that includes materials testing or trialling activities, industry visits, technical reports.

Where teachers allow students to choose between tasks they must ensure that the tasks they set are of comparable scope and demand.

Unit 3: Applying the product design process

In this unit students are engaged in the design and development of a product that addresses a personal, local, or global problem (such as humanitarian issues), or that meets the needs and wants of a potential end-user/s. The product is developed through a design process and is influenced by a range of factors including the purpose, function and context of the product; user-centred design; innovation and creativity; design elements and principles; 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 vary 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 an end-user/s. Students identify methods which could be used in a low-volume or mass/high-volume production setting to manufacture a similar product to their design.

In the initial stage of the product design process a design brief is prepared, outlining the context or situation around the design problem and describing the needs and requirements in the form of constraints or considerations.

In Area of Study 1, students examine how a design brief 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 digital technologies, 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 an end-user/s, including writing an individual design brief and criteria that will be used to evaluate the product in Unit 4.

Area of Study 1

Designing for end-user/s

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 identifying and designing for a potential end-user/s of an intended product. They consider methods used to establish an end-user/s' needs for the development of a solution to a design problem.

Using problem-based design scenarios provided by the teacher, students identify appropriate product design factors and write a design brief. In the design brief, students outline the context and express the requirements as constraints and considerations. They annotate this design brief, develop evaluation criteria, identify areas for research and outline design ideas from the brief.

The design brief developed in Outcome 1 needs to be different to that developed in Outcome 3 of this unit.

Outcome 1

On completion of this unit the student should be able to investigate and define a design problem, and discuss 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 relationship between designer and end-user/s and their respective roles
- stages and steps of the initial stages of the product design process
- product design factors that influence the designer
- use of appropriate market research methods to explore product design factors identified for an end-user/s
- methods used by a designer to create a design brief, including collecting, recording and developing relevant information about the design problem and the specific requirements of the end-user/s, and reference to product design factors
- the purpose and structure of evaluation criteria
- 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
- develop a design brief and identify aspects that require research
- outline research to explore and develop creative design ideas to meet the requirements of the design brief
- develop evaluation criteria based on the design brief.

Area of Study 2

Product development in industry

This area of study focuses 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 are integral to value-adding to products. They also examine how companies react to market demands and technological developments. Students look at the role of market research in determining end-user/s' needs in relation to sustainability.

Students investigate the use of computer-aided design (CAD) and computer-aided manufacture (CAM) and new and emerging technologies and materials used in industry. In the context of industrial manufacturing, they develop an understanding of a range of issues relating to innovation, designing, research and development, obsolescence and sustainability.

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 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: laser technology; robotics; computer-aided design (CAD); computer-aided manufacture (CAM); computer numerical control (CNC); rapid 3D prototyping
- the importance of lean manufacturing as it relates to flexible and responsive manufacturing
- design and innovation and their importance in the product development process
- the relationship between market research and the product development process
- sustainability frameworks and strategies that influence design, production and distribution:
  - life cycle analysis/assessment (LCA)
  - cradle to cradle concept
  - Design for Disassembly (DfD)
  - Extended Producer Responsibility (EPR) or product stewardship
- planned obsolescence in terms of style, technical and functional
- benefits and problems for the producer and consumer, and associated environmental issues with planned obsolescence
- methods and suitability of different scales of manufacturing systems, including one-off, low-volume, mass/high-volume and continuous production.

Key skills

- explain 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
- graphically represent and describe the product development process in industry
- analyse the benefits and problems of planned obsolescence
- analyse the systems and models of sustainability that influence design, manufacturing and marketing in industry
- compare one-off, low-volume, mass/high-volume production and continuous manufacturing systems and the types of products that result from these production scales.

Area of Study 3

Designing for others

This area of study focuses on students working as designers and applying the product design process to meet the requirements of an end-user/s. Students identify specific needs of the end-user/s by referring to the product design factors and conducting research. Students prepare a design brief that guides their work for this area of study and for 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 for obtaining end-user/s' feedback. They appropriately acknowledge resources and the IP of others. Students use creative and critical design thinking techniques throughout the product design process.

Students use evaluation criteria and end-user/s' feedback to select a design option justifying their informed selection of the preferred design. The criteria are also developed with the intention of evaluating the finished product. Students then develop working drawings, using appropriate conventions.

Production planning includes: material testing or trialling, selection and procurement; selection of appropriate production processes, including some which are complex, and development of a scheduled production plan and a risk assessment; and development of product specifications and identification of quality measures. Suitable materials are to be selected from those listed on page 12. After commencing production, students document their progress and explain and justify any production modifications.

The design brief developed in Outcome 3 needs to be different to that developed in Outcome 1 of this unit.

Outcome 3

On completion of this unit the student should be able to document the product design process used to meet the needs of an end-user/s, 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 to achieve a quality product for an end-user/s
- methods of accessing, analysing, organising and presenting relevant data and information used to determine the needs of an end-user/s
- product design factors relevant to identified problems, needs or opportunities
- the role of criteria to inform and justify design option selection and evaluate the finished product
- methods of exploring, researching and testing the characteristics and properties of materials to determine their suitability, and processes applicable to the development of the design
- the use of creative and critical design thinking techniques including digital technologies where appropriate, to develop design ideas, and methods of communicating these ideas and gaining feedback from end-user/s
- the purpose and role of annotated visualisations (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: assembly and detail drawings, templates, flats, plans, patterns and notations, as appropriate
- tools, equipment, machinery, facilities and other factors that influence productivity
- the role and components of production planning:
  - a scheduled work plan with timeline, production steps, materials, tools, equipment and machines, quality measures and estimated time to complete processes
  - a risk assessment
  - a materials and costing list
- techniques used to record progress and reasons for modifications to the design, planning and production plans
- methods of manufacturing in a mass/high-volume production or low-volume setting.

Key skills

- conduct research using interviews or market research to create an end user/s' profile
- develop evaluation criteria to be used for both design options and the finished product
- conduct and present research relevant to the design brief, appropriately acknowledging sources and IP of others
- use a range of visualisations, drawing and communication methods, including digital technologies where appropriate
- use end-user/s' feedback to select and justify the preferred design option
- prepare a scheduled production plan
- research, test and use experimentation techniques and/or trial processes to ascertain appropriateness of characteristics and properties of materials for the product design
- record progress of production activities and explain and justify modifications and improvements
- identify relevant manufacturing processes needed to enable mass/high-volume or low-volume production of the preferred design.

School-based assessment

Satisfactory completion

The award of satisfactory completion for a unit is based on whether the student has demonstrated the set of outcomes specified for the unit. Teachers should use a variety of learning activities and assessment tasks to provide a range of opportunities for students to demonstrate the key knowledge and key skills in the outcomes.

The areas of study and key knowledge and key skills listed for the outcomes should be used for course design and the development of learning activities and assessment tasks.

Assessment of levels of achievement

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

School-assessed Coursework 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 School-assessed Coursework task, they should ensure that the options are of comparable scope and demand.

The types and range of forms of School-assessed Coursework for the outcomes are prescribed within the study design. The VCAA publishes *Advice for teachers* for this study, which includes advice on the design of assessment tasks and the assessment of student work for a level of achievement.

Teachers will provide to the VCAA a numerical score representing an assessment of the student's level of achievement. The score must be based on the teacher's assessment of the performance of each student on the tasks set out in the following table.

Contribution to final assessment

School-assessed Coursework for Unit 3 will contribute 12 per cent to the study score.

Outcomes	Marks allocated	Assessment tasks
Outcome 1 Investigate and define a design problem, and discuss how the design process leads to product design development.	25	A structured, annotated design brief, evaluation criteria and an explanation of how the designer will research and develop design ideas from the design brief, with reference to product design factors.
Outcome 2 Explain and analyse influences on the design, development and manufacture of products within industrial settings.	35	The student's performance on the outcome is assessed using one or more of the following: • extended response • a short written report • an oral presentation accompanied by notes and/or visual materials.
Total marks	60	

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. Details of the School-assessed Task for Units 3 and 4 are provided on page 30 of this study design.

External assessment

The level of achievement for Units 3 and 4 is also assessed by an end-of-year examination, which will contribute 30 per cent.

Unit 4: Product development and evaluation

In this unit students engage with an end-user/s to gain feedback throughout the process of production. Students make comparisons between similar products to help evaluate 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 quality of their product with reference to criteria and end-user/s' feedback. Students make judgments about possible improvements. They produce relevant user instructions or care labels that highlight the product's features for an end-user/s.

Area of Study 1

Product analysis and comparison

In this area of study students examine design factors that influence the success of commercially available products. Products are analysed and evaluated in terms of the product design factors. Students develop an understanding of what people value and how they evaluate 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, commercially produced products fulfil their purpose.

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 similar commercial products, including user trials
- environmental, economic and social issues associated with products that may be of concern and consequence to potential purchasers and end-user/s
- how designers, manufacturers, end-user/s 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

- 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 an end-user/s. Students continue to implement their scheduled 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.

Students select appropriate construction materials from the list on page 12.

Outcome 2

On completion of this unit the student should be able to apply a range of production skills and processes safely 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 management 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
- techniques of monitoring efficiency and effectiveness of planning and production activities
- methods used to record and report progress, including decisions and modifications made during the production process.

Key skills

- apply risk management throughout production
- use tools, equipment and machines, and materials competently and safely
- use appropriate processes safely and accurately
- use quality measures identified in the scheduled production plan to ensure a quality outcome is achieved
- use appropriate techniques to record and report progress and modifications on production activities.

Area of Study 3

Product evaluation

This area of study focuses on the student's application of evaluation criteria, the performance of checks and tests, and gaining end-user/s' feedback to determine how well a product meets the needs and requirements outlined in the design brief developed in Unit 3.

Students produce relevant end-user/s' instructions or care labels that highlight features of the product they have designed and made. User instructions or care labels may include methods of caring for the product to prolong its life, and operational, assembly and repair instructions.

Outcome 3

On completion of this unit the student should be able to evaluate the finished product through testing and feedback against criteria, create end-user/s' instructions or care labels and recommend improvements to future products.

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 end-user/s' feedback with reference to evaluation criteria for the finished product
- methods of testing and checking the finished product against evaluation criteria
- methods of creating end-user/s instructions or care labels
- possible improvements to the product as a result of evaluation.

Key skills

- use testing and/or checking methods on the finished product to explain and evaluate product performance and possible improvements
- gather and summarise feedback from a potential end-user/s in relation to the finished product
- evaluate the finished product to determine the extent to which it meets the needs of the end-user/s according to the requirements of the design brief
- produce a set of instructions or care labels for an end-user/s
- determine and recommend improvements to the product.

School-based assessment

Satisfactory completion

The award of satisfactory completion for a unit is based on whether the student has demonstrated the set of outcomes specified for the unit. Teachers should use a variety of learning activities and assessment tasks to provide a range of opportunities for students to demonstrate the key knowledge and key skills in the outcomes.

The areas of study and key knowledge and key skills listed for the outcomes should be used for course design and the development of learning activities and assessment tasks.

Assessment of levels of achievement

The student's level of achievement in Unit 4 will be determined by School-assessed Coursework and a School-assessed Task.

School-assessed Coursework 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 School-assessed Coursework task, they should ensure that the options are of comparable scope and demand.

The types and range of forms of School-assessed Coursework for the outcomes are prescribed within the study design. The VCAA publishes *Advice for teachers* for this study, which includes advice on the design of assessment tasks and the assessment of student work for a level of achievement.

Teachers will provide to the VCAA a numerical score representing an assessment of the student's level of achievement. The score must be based on the teacher's assessment of the performance of each student on the tasks set out in the following table.

Contribution to final assessment

School-assessed Coursework for Unit 4 will contribute 8 per cent to the study score.

Outcome	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	The student's performance on the outcome is assessed using one or more of the following: • an extended response • a short written report • structured questions • an oral presentation accompanied by notes • an annotated visual report.
Total marks	40	

School-assessed Task

Assessment for Product Design and Technology includes a School-assessed Task. For this assessment teachers will provide to the VCAA 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 online by the VCAA.

Outcomes	Assessment tasks
Unit 3 **Outcome 3** Document the product design process used to meet the needs of an end-user/s, and commence production of the designed product.	• A folio comprising: – An end-user/s' profile, a design brief, evaluation criteria, research, visualisations, design options with justification of the selected option, working drawings of final option, a scheduled production plan, a list of relevant processes used for larger scale production, and a record of progress and modifications. The design folio must include documentation of decisions, and acknowledge sources of information. – Production work accompanied by a record of production progress and documentation of modifications with justification of these changes (text and images should be included).
Unit 4 **Outcome 2** Apply a range of production skills and processes safely to make the product designed in Unit 3, and manage time and resources effectively and efficiently.	AND • A functional product that conforms to standards of quality indicated in the design brief outline of context.
Outcome 3 Evaluate the finished product through testing and feedback against the criteria, create end-user/s' instructions or care labels and recommend improvements to future products.	AND • A written report that includes evaluation of the product. AND • Relevant end-user/s instructions or care labels which highlight the features, assembly, care and/or repair of the product in any of the following formats: video tutorials, annotated image of the product or other multimedia format.

School-assessed Task for Units 3 and 4 contributes 50 per cent.

External assessment

The level of achievement for Units 3 and 4 is also assessed by an end-of-year examination.

Contribution to final assessment

The examination will contribute 30 per cent.

End-of-year examination

Description

The examination will be set by a panel appointed by the VCAA. All the key knowledge and key skills that underpin the outcomes in Units 3 and 4 are examinable.

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 VCAA.
- VCAA 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 VCAA.

Further advice

The VCAA publishes specifications for all VCE examinations on the VCAA 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 Unit 3 and 4 sequence together with any sample material.