

Advanced Higher Design and Manufacture Draft Course/Unit Support Notes



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Please refer to the note of changes at the end of this document for details of changes from previous version (where applicable).

Contents

Introduction	1
General guidance on the Course/Units	2
Approaches to learning and teaching	5
Approaches to assessment	9
Equality and inclusion	16
Appendix 1: Further information on Units in the Course	17
Appendix 2: Reference documents	38

Introduction

These support notes are not mandatory. They provide advice and guidance on approaches to delivering and assessing the Advanced Higher Design and Manufacture Course. They are intended for teachers and lecturers who are delivering the Course and its Units. They should be read in conjunction with the *Course Specification*, the *Course Assessment Specification* and the *Unit Specifications* for the Units in the Course.

These support notes cover both the Advanced Higher Course and the Units in it.

General guidance on the Course/Units

Aims

The aims of the Course are to enable learners to:

- ◆ develop understanding and skills in the processes of designing for the manufacture of products in commercial and industrial contexts
- ◆ develop and apply an understanding of the factors which influence thinking for product design and manufacturing activities
- ◆ develop a critical and visual awareness associated with requirements for user interface and product detailing
- ◆ develop independence in learning and enquiry skills in the context of problem solving in designing and manufacturing
- ◆ develop economic, social and environmental awareness of the implications of a product's design through its life cycle

Progression

Entry to this Course is at the discretion of the centre. However, learners would normally be expected to have attained the skills, knowledge and understanding required by Higher Design and Manufacture or equivalent qualifications and/or experience:

Learners who have achieved this Advanced Higher Course may progress to further study, employment and/or training. Opportunities for progression include:

- ◆ Progression to other SQA qualifications
 - Progression to other qualifications at the same level of the Course, for example Professional Development Awards (PDAs) , Higher National Certificates (HNCs)
- ◆ Progression to further/higher education
 - For many learners a key transition point will be to further or higher education, for example to Higher National Certificates (HNCs)/Higher National Diplomas (HNDs) or degree programmes. Examples of further and higher education programmes that learners might progress to are a range of design and/or manufacturing-related qualifications.
 - This Course provide good preparation for learners progressing to further and higher education as learners doing Advanced Higher Courses must be able to work with more independence and less supervision. This eases their transition to further/higher education. Advanced Higher Courses may also allow 'advanced standing' or partial credit towards the first year of study of a degree programme.
 - Advanced Higher Courses are challenging and testing qualifications — learners who have achieved multiple Advanced Higher Courses are regarded as having a proven level of ability which attests to their

readiness for higher education in HEIs in other parts of the UK as well as in Scotland.

- ◆ Progression to employment
 - For many learners progression will be directly to employment or work-based training programmes. Examples of employment opportunities and training programmes are careers in design and/or manufacturing design fields.

Skills, knowledge and understanding covered in this Course

This section provides further advice and guidance about skills, knowledge and understanding that could be included in the Course.

Teachers and lecturers should refer to the *Course Assessment Specification* for mandatory information about the skills, knowledge and understanding to be covered in this Course.

The development of subject specific and generic skills is central to the Course. Learners should be made aware of the skills they are developing and of the transferability of them. It is the transferability that will help learners with further study and enhance their personal effectiveness.

The list below shows the skills, knowledge and understanding that will be developed throughout the Course. There will be opportunities to develop these across the Units in the Course. However, the delivery mode adopted and the approaches to learning and teaching will determine how and where the opportunities arise.

- ◆ analysing often complex aspects and activities which surround and support commercial product design and manufacture in developing, synthesising and presenting effective proposals
- ◆ exploring contemporary techniques for three-dimensional visualisation of solutions in product design and manufacturing activities
- ◆ applying a range of techniques for visualising, modelling, testing and evaluating design proposals
- ◆ developing skills, techniques and strategies for communicating ideas appropriate to a range of audiences and users
- ◆ developing knowledge and understanding of the role of product design and manufacturing in contributing to a global economy
- ◆ developing a critical understanding of factors which influence and support commercial product development — past, present and future
- ◆ applying ethical, social, and environmental considerations in the decision making process of product design and development
- ◆ planning, managing and undertaking a significant design and manufacture project

Skills, knowledge and understanding to be included in the Course will be appropriate to the SCQF level of the Course. The SCQF level descriptors give further information on characteristics and expected performance at each SCQF level (www.sqa.org.uk/scqf).

Approaches to learning and teaching

The Advanced Higher Design and Manufacture Course will allow learners to explore the multi-faceted world of product design and manufacturing in an increasingly commercial and industrialised context.

The Course focuses on creativity and innovation in the contexts of product design and manufacture. Learners will have opportunities to make good use of their knowledge and skills already obtained across their learning experiences, for example drawing on numeracy and science when considering technical details and operational principles, and on aspects of social sciences when considering aspects of environmentalism and ethics, as well as other areas of the curriculum, personal experiences and interests. It is in this integrative quality that the Course demonstrates broad options, possibilities and flexibilities in supporting personal growth.

The challenges and activities for learning in the Course encourage learners to become successful, responsible and creative in their use of design and manufacturing skills and technologies, and to continue to acquire and develop the attributes and capabilities of the four capacities, including: creativity, flexibility and adaptability; enthusiasm and a willingness to learn; perseverance, independence and resilience; responsibility and reliability; and confidence and enterprise. In addition, a Course of this nature should prepare the learner to be able to understand the effects of design and manufacturing decisions, and promote self-awareness and responsibilities in environmental stewardship. Through these challenges and activities, learners should find learning an enjoyable and engaging experience.

Advanced Higher Courses place more demands on learners as there is a higher proportion of independent study and less direct supervision. Some of the approaches to learning and teaching suggested for other levels (in particular, Higher) may also apply at Advanced Higher level but there will be a stronger emphasis on independent learning.

For Advanced Higher Courses, a significant amount of learning may be self-directed and require learners to demonstrate a more mature approach to learning and the ability to work on their own initiative. This can be very challenging for some learners, who may feel isolated at times, and teachers and lecturers should have strategies for addressing this. These could include, for example, planning time for regular feedback sessions/discussions on a one-to-one basis and on a group basis led by the teacher or lecturer (where appropriate).

Teachers and lecturers should encourage learners to use an enquiring, critical and problem-solving approach to their learning. Learners should also be given the opportunity to practise and develop research and investigation skills and higher-order evaluation and analytical skills. The use of Information and Communications Technology (ICT) can make a significant contribution to the

development of these higher-order skills as research and investigation activities become more sophisticated.

Learners will engage in a variety of learning activities as appropriate to the subject, for example:

- ◆ researching information for their subject rather than receiving information from their teacher or lecturer
- ◆ using active and open-ended learning activities such as research, case studies and presentation tasks
- ◆ making use of the internet to draw conclusions about specific issues
- ◆ recording in a systematic way the results of research and independent investigation from different sources
- ◆ participating in group work with peers and using collaborative learning opportunities to develop team working
- ◆ drawing conclusions from complex information
- ◆ using appropriate technological resources (eg web-based resources)
- ◆ using appropriate media resources (eg video clips)
- ◆ demonstrating development, improvement and refinement of techniques and practices in practical based subjects
- ◆ using real-life contexts and experiences familiar and relevant to young people to meaningfully hone and exemplify skills, knowledge and understanding
- ◆ participating in field trips and visits

Teachers and lecturers should support learners by having regular discussions with them and giving regular feedback. Some learning and teaching activities may be carried out on a group basis and, where this applies, learners could also receive feedback from their peers.

The Course stresses the integration of designing and manufacturing as a connected activity and that design is an iterative process. The Course highlights the close relationship between designing, making, modelling, testing, and refining and presenting design ideas.

The Course will build on the knowledge, understanding and skills developed by the learner in the Higher Design and Manufacture Course and will provide a useful bridge towards further study of related disciplines in higher education. The Course allows learners to consider the various factors that impact on a product's design. It will consider the life cycle of a product from its inception through design, manufacture, use, re-use and the impacts and consequences of the product's disposal.

As creative industries strive to compete in a global design and manufacturing marketplace and build commercial partnerships across the world, it is important that they continue to build capacity and nurture forward thinking, innovative, talented, and informed designers and manufacturers. Advanced Higher Design and Manufacture provides experiences that support these qualities.

Teachers and lecturers should, where possible, provide opportunities to personalise learning, and enable learners to have choices in approaches to

learning and teaching – the flexibility of Advanced Higher Courses and the independence with which learners carry out the work lend themselves to this. Teachers and lecturers should also create opportunities for, and use, inclusive approaches to learning and teaching. This can be achieved by encouraging the use of a variety of learning and teaching strategies that suit the needs of all learners. Innovative and creative ways of using technology can also be valuable in creating inclusive learning and teaching approaches.

Centres are free to sequence the teaching of the Outcomes, Units and/or Course in any order they wish. However the following models are suggested:

Potential delivery styles and timings of the Units are shown below:

Concurrent model

Product Analysis	Product Evolution	Course assessment
Product Development		

When the concurrent model (shown above) is followed, the intention is not to integrate the Units, more allow for the continual development of design skills throughout the year. This approach is more natural and allows the learners to keep skills current.

Sequential model

Product Analysis	Product Evolution	Product Development	Course assessment
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When a sequential approach is undertaken the *Product Analysis* and *Product Evolution* Units can be placed in any order, but it is suggested that the *Product Development* Unit is placed after either of the other two Units. This will potentially allow the learners to build on work from their *Product Analysis* or *Product Evolution* and provide a natural starting point.

Further information is given in Appendix 1.

Developing skills for learning, skills for life and skills for work

The following skills for learning, skills for life and skills for work should be developed in this Course.

2 Numeracy

2.3 Information handling

4 Employability, enterprise and citizenship

4.1 Employability

4.2 Information and communication technology (ICT)

5 Thinking skills

5.4 Analysing and evaluating

5.5 Creating

Teachers and lecturers should ensure that learners have opportunities to develop these skills as an integral part of their learning experience.

It is important that learners are aware of the skills for learning, skills for life and skills for work that they are developing in the Course and the activities they are involved in that provide realistic opportunities to practise and/or improve them.

At Advanced Higher level it is expected that learners will be using a range of higher-order thinking skills. They will also develop skills in independent and autonomous learning.

Approaches to assessment

The Course assessment will consist of two Components: a project and a question paper.

Component 1: project

The purpose of the project is to assess the practical application of knowledge and skills to develop a solution to an appropriately challenging and complex design and manufacture task requiring challenge and application. It will assess the learner's skills in identifying opportunities to design and present solutions to satisfy perceived product needs, research target markets, visualise a range of solutions, test and critically evaluate the solution, and record the process.

The project will have 150 marks (60% of the total mark).

Time will be required for:

- ◆ preparation for the project, which could include establishing the brief and/or liaising with a partnered client
- ◆ defining the aims and objectives of the project, creating a project plan, identifying tasks and undertaking research activities and background reading
- ◆ creating a range of design proposals and synthesising towards a solution
- ◆ selecting and developing and refining a final design proposal
- ◆ evaluating the solution and the process
- ◆ presenting final design work
- ◆ recording the stages of the project and self-evaluation

Evidence will be produced through the learner's response to a self-generated brief or through a partnership arrangement.

Marks will be awarded for:

- ◆ Research and planning activities (10%)
- ◆ Application of the design process, including:
 - Developing and synthesising a range of concepts and design proposals (40%)
 - Communication through visualisation techniques and/or modelling, including manufacturing and materials (20%)
 - Evaluating the solution (20%)
- ◆ Recording the process and creating a client presentation (10%)

Component 2: question paper

The purpose of the question paper is to assess learners' skills, knowledge and understanding they have acquired. The question paper component of the Course will have 100 marks (40% of the total mark) and is in two sections.

The question paper will give learners an opportunity to:

- ◆ demonstrate their understanding of the design process in a commercial context
- ◆ demonstrate their understanding of materials and manufacturing processes
- ◆ comment on historic design influences in terms of technology, materials and manufacturing processes
- ◆ demonstrate their understanding of visualisation techniques and technologies and their application
- ◆ demonstrate reasoning ability by determining and applying design factors to specific design situations
- ◆ demonstrate an understanding of the influences and needs of markets and users
- ◆ comment on the impact of commercial design and manufacturing decisions on the environment and society

The question paper will consist of extended response questions and will give learners the opportunity to demonstrate the application of knowledge and understanding to answer questions by drawing on and applying knowledge and understanding from the table provided in the 'Further mandatory information on Course coverage' section in the *Course Assessment Specification*.

Assessment in Advanced Higher Courses will generally reflect the investigative nature of Courses at this level, together with high-level problem-solving and critical thinking skills and skills of analysis and synthesis.

This emphasis on higher-order skills, together with the more independent learning approaches that learners will use, distinguishes the added value at Advanced Higher level from the added value at other levels.

There are different approaches to assessment, and teachers and lecturers should use their professional judgement, subject knowledge and experience, as well as understanding of their learners and their varying needs, to determine the most appropriate ones and, where necessary, to consider workable alternatives.

Assessments must be fit for purpose and should allow for consistent judgements to be made by all teachers and lecturers. They should also be conducted in a supervised manner to ensure that the evidence provided is valid and reliable.

Unit assessment

All Units are internally assessed against the requirements shown in the *Unit Specification*.

Assessments must ensure that the evidence generated demonstrates, at the least, the minimum level of competence for each Unit. Teachers and lecturers preparing assessment methods should be clear about what that evidence will look like.

Sources of evidence likely to be suitable for Advanced Higher Units could include:

- ◆ meaningful contribution to group work and/or discussions (making use of log books, blogs, question and answer sessions to confirm individual learners have met the required standards)
- ◆ presentation of information to other groups and/or recorded oral evidence
- ◆ exemplification of concepts using (for example) a diagram
- ◆ interpretation of numerical data
- ◆ practical demonstration with commentary/explanation/narrative
- ◆ investigations
- ◆ answers to multiple choice questions
- ◆ short written responses
- ◆ extended response essay-type questions

Evidence should include the use of appropriate subject-specific terminology as well as the use of real-life examples where appropriate.

Flexibility in the method of assessment provides opportunities for learners to demonstrate attainment in a variety of ways and so reduce barriers to attainment.

The structure of an assessment used by a centre can take a variety of forms, for example:

- ◆ individual pieces of work could be collected in a folio as evidence for Outcomes and Assessment Standards
- ◆ assessment of each complete Outcome
- ◆ assessment that combines the Outcomes of one or more Units
- ◆ assessment that requires more than the minimum competence, which would allow learners to prepare for the Course assessment

Teachers and lecturers should note that learners' day-to-day work may produce evidence which satisfies assessment requirements of a Unit, or Units, either in full or partially. Such naturally occurring evidence may be used as a contribution towards Unit assessment. However, this naturally occurring evidence must still be recorded and evidence such as written reports, recording forms, PowerPoint slides, drawings/graphs, video footage or observational checklists provided.

Combining assessment across Units

The assessment of the Units in this Course will be as follows.

Product Analysis (Advanced Higher)

For this Unit, learners will be required to provide evidence of:

- ◆ critical analysis of the aspects, activities and factors which surround and support the design, development and manufacture of commercial products
- ◆ knowledge and understanding of the contributory role of product design and manufacturing in a global economy

Product Development (Advanced Higher)

For this Unit, learners will be required to provide evidence of:

- ◆ effective analysis, leading to development, synthesis and presentation of design proposals
- ◆ informed application of ethical, social and environmental considerations in making design decisions
- ◆ effective selection and application of contemporary visualisation techniques appropriate to ranges of purpose and audience

Product Evolution (Advanced Higher)

For this Unit, learners will be required to:

- ◆ provide evidence of knowledge and critical understanding of the key historical, technological, social and environmental developments and thinking which have influenced designed and manufactured products, drawing conclusions for future research and product development opportunities and activities

Opportunities for combining assessment exist in the Units of this Course. Further advice is given in appendix 1.

Units will be assessed on a pass/fail basis. All Units are internally assessed against the requirements shown in the *Unit Specification*. Each Unit can be assessed on an individual Outcome-by-Outcome basis or via the use of combined assessment for some or all Outcomes.

A combined approach to assessment will enrich the assessment process for the learner, avoid duplication of tasks and allow more emphasis on learning and teaching. Evidence could be drawn from a range of activities for a combined assessment. Care must be taken to ensure that combined assessments provide appropriate evidence for all the Outcomes that they claim to assess.

Combining assessment will also give centres more time to manage the assessment process more efficiently. When combining assessments across Units, teachers/lecturers should use e-assessment wherever possible. Learners can easily update portfolios, electronic or written diaries and recording sheets.

For some Advanced Higher Courses, it may be that a strand of work which contributes to a Course assessment method is started when a Unit is being delivered and is completed in the Course assessment. In these cases, it is important that the evidence for the Unit assessment is clearly distinguishable from that required for the Course assessment.

Preparation for Course assessment

Each Course has additional time which may be used at the discretion of the teacher or lecturer to enable learners to prepare for Course assessment. This time may be used near the start of the Course and at various points throughout the Course for consolidation and support. It may also be used for preparation for Unit assessment, and, towards the end of the Course, for further integration, revision and preparation and/or gathering evidence for Course assessment.

For this Advanced Higher Course, the assessment methods for Course assessment are a project and a question paper. Learners should be given opportunities to practise these methods and prepare for them.

The project component of the Course has 150 marks (60% of the total mark) and requires time for:

- ◆ preparation for the project, which could include establishing the brief and/or liaising with a partnered client
- ◆ defining the aims and objectives of the project, creating a project plan, identifying tasks and undertaking research activities and background reading
- ◆ practising and refining practical skills
- ◆ creating a range of design proposals and synthesising towards a solution
- ◆ selecting and developing and refining a final design proposal
- ◆ evaluating the solution and the process
- ◆ presenting final design work
- ◆ recording the stages of the project, evaluating and analysing findings, developing and justifying conclusions, presenting the information and self-evaluation.

In relation to preparing for the project, teachers and lecturers should explain requirements to learners and the amount and nature of the support they can expect. However, at Advanced Higher level it is expected that learners will work with more independence and less supervision and support.

The question paper component of the Course will have 100 marks (40% of the total mark) and is in two sections, time is required for practising question paper techniques and revising for the question paper. Teachers/lecturers need to ensure that learners have the opportunity to practise:

- ◆ demonstrating their understanding of the design process in a commercial context
- ◆ demonstrating their understanding of materials and manufacturing processes
- ◆ commenting on historic design influences in terms of technology, materials and manufacturing processes
- ◆ demonstrating their understanding of visualisation techniques and technologies and their application
- ◆ demonstrating reasoning ability by determining and applying design factors to specific design situations

- ◆ demonstrating an understanding of the influences and needs of markets and users
- ◆ commenting on the impact of commercial design and manufacturing decisions on the environment and society

Authenticity

In terms of authenticity, there are a number of techniques and strategies to ensure that learners present work that is their own. Teachers and lecturers should put in place mechanisms to authenticate learner evidence.

In Advanced Higher Courses, because learners will take greater responsibility for their own learning and work more independently, so teachers and lecturers need to have measures in place to ensure that work produced is the learner's own work.

For example:

- ◆ regular checkpoint/progress meetings with learners
- ◆ short spot-check personal interviews
- ◆ checklists which record activity/progress
- ◆ photographs, films or audio records.

Group work approaches as part of the preparation for assessment can be helpful to simulate real-life situations, share tasks and promote team-working skills. However, group work is not appropriate once formal assessed work has started.

For more information, please refer to SQA's *Guide to Assessment*.

Added value

Advanced Higher Courses include assessment of added value, which is assessed in the Course assessment.

Information given in the *Course Specification* and the *Course Assessment Specification* about the assessment of added value is mandatory.

In Advanced Higher Courses, added value involves the assessment of higher-order skills such as high-level and more sophisticated investigation and research skills, critical thinking skills and skills of analysis and synthesis. Learners may be required to analyse and reflect upon their assessment activity by commenting on it and/or drawing conclusions with commentary/justification. These skills contribute to the uniqueness of Advanced Higher Courses and to the overall higher level of performance expected at this level.

In this Course, added value will be assessed by means of a project and a question paper.

To achieve success in the Course, learners must show that they are able to apply these to respond effectively to situations in both practical and theoretical design and manufacturing contexts.

In this Course assessment, added value will focus on the following:

- ◆ breadth — drawing on knowledge and skills from across the Course
- ◆ challenge — requiring greater depth or extension of knowledge and/or skills
- ◆ application — requiring application of knowledge and/or skills in practical or theoretical contexts as appropriate

Through the Design and Manufacture Units, the learner will develop a range of professional techniques and skills in the designing of products to satisfy needs and solve problems. These skills, partnered with underpinning knowledge and understanding of the design and production of commercial products, enables learners to undertake the requirements of the added value. The added value will be assessed through a learner-generated design and manufacturing project and a question paper.

The project will require the learner to produce a designed solution to a realistic or actual commercial product design and development task. This will allow the learner to confirm their capabilities through challenge and application.

The question paper will require learners to demonstrate aspects of breadth and application in a graphic context, based on recognised professional approaches and principles in the commercial product design industries.

This will be achieved through:

- ◆ applying knowledge and understanding from across the Course to describe and explain professional design principles and practices
- ◆ applying knowledge and understanding from across the Course to describe, explain and justify the use of materials and commercial manufacturing processes
- ◆ applying knowledge and understanding from across the Course to comment on factors which influence design decisions and the impact of those decisions made
- ◆ applying skills and knowledge from across the Course to produce a design solution to a potentially complex problem

Equality and inclusion

It is recognised that centres have their own duties under equality and other legislation and policy initiatives. The guidance given in these *Course/Unit Support Notes* is designed to sit alongside these duties but is specific to the delivery and assessment of the Course.

It is important that centres are aware of and understand SQA's assessment arrangements for disabled learners, and those with additional support needs, when making requests for adjustments to published assessment arrangements. Centres will find more guidance on this in the series of publications on Assessment Arrangements on SQA's website: www.sqa.org.uk/sqa/14977.html.

The greater flexibility and choice in Advanced Higher Courses provide opportunities to meet a range of learners' needs and may remove the need for learners to have assessment arrangements. However, where a disabled learner needs a reasonable adjustment/assessment arrangements to be made, you should refer to the guidance given in the above link.

Appendix 1: Further information on Units in the Course

The following gives details of mandatory skills, knowledge and understanding for the Advanced Higher Design and Manufacture Course. Course assessment will involve sampling the skills, knowledge and understanding. This list of skills, knowledge and understanding also provides the basis for the assessment of the Units of the Course.

The Course assessment (project and question paper) will require learners to draw on and apply knowledge of any of the concepts listed below. This table should be read in conjunction with the descriptions of the project and the question paper.

The following gives details of the skills, knowledge and understanding and can be found in the *Course Assessment Specification*.

Advanced Higher Design and Manufacture	
DESIGNING	
Market	Consumer demands, social expectations, niche marketing, branding, introduction of new products. Endorsements, product placement, product promotion, market trends, product life cycle. Product failures (reasons, results and corrections). Changing markets. Influence of politics and the economy. Methods of maintaining market share.
Product re-design	Reasons, alternatives, re-launch of products, product testing, identification of problems with existing products.
Aesthetics	Factors influencing aesthetics, influences of fashion, market trends, style.
Ergonomics	Anthropometrics, psychology, physiology. Use of percentiles, user interface, inclusive design, consumer safety.
Economics	Costs (fixed and variable), safety (British Standards, kite marks), market opportunity, intellectual property rights (confidentiality, patents, copyrights, design rights, trademarks, registered designs), value for money, production systems.
Conflict resolution	Resolution and balance between competing design issues during design and manufacture of products (eg function versus aesthetics, economics versus environment). Relationships between consumer, designer and manufacturer.

Evolution of products		The critical stages, and the historical development and impact of: materials and manufacturing technologies, socio-economics, fashion and style, and influential designers and design movements.
Environmental		Sustainability in manufacture, use and re-use, packaging. Climate change, carbon footprints, sustainable resources, mass production and efficiency, green design, government policy, recycling, consumer awareness/changing attitudes.
Visualisation	Graphic techniques	Annotated sketches, working drawings, pictorial views exploded views, dimensioned views, illustration techniques, computer-aided graphics, and use of scale. The role of graphics in the design process. Use of graphic techniques to develop and communicate ideas. Orthographic drawing (elevation, end elevation, plan, outline, hidden detail, centre-line, dimensioning, section, hatch lines — all to BS conventions). Detail in drawings (wall thicknesses, fillet radii, rib details).
	Modelling	Scale models, mock-ups, fully crafted prototypes, test models, computer generated models, part-product models, simulations, rapid prototyping. Use of appropriate modelling materials such as paper, card, corrugated card, MDF, wire, pipe cleaners, foam, clay, modelling putty, balsa wood, expanded foam, sheet plastic, construction kits. The role of modelling in the design process. Application of modelling techniques to develop and communicate ideas. Detail, progression of models.
	Presenting design responses	Justification, iteration and testing
MANUFACTURING		
Materials	Plastics	Polythene (high and low density), polyvinyl chloride, polystyrene, nylon, cellulose acetate, acrylic, polypropylene, ABS, epoxy resin, melamine formaldehyde, urea formaldehyde, polyester resin, glass-reinforced plastic, carbon-fibre plastics, elastomers.
	Biodegradable polymers	Bio-degradable polymers (bio-batch), compostable polymers — corn starch-based, eg Polyactide (PLA). Applications for biodegradable polymers, eg carrier bags,

		plastic bottles and detergent sachets.
	Composites	Fibre reinforced polymers, GRP, Kevlar, carbon fibre.
	Metals	Mild steel, high carbon steel, stainless steel, cast iron, brass, bronze, duralumin, aluminium, copper, tin, lead, zinc.
	Woods	Beech, oak, ash, mahogany, teak, walnut, balsa, Scots pine, red cedar, parana pine, spruce.
	Timber derivatives	Manufactured boards (medium density fibreboard, plywood, block-board, chipboard, hardboard), veneer.
Identification of materials		Colour, surface texture, weight, properties, labelling and symbols.
Processes	Metals	Turning, milling, die-casting, pressing, stamping, punching, joining (spot welding, arc welding, riveting, adhesives, fitted joints, bolts, screws, patent devices), sand casting, casting, piercing and blanking, forging, finishing.
	Plastics	Injection-moulding, extrusion, rotational moulding, vacuum-forming, blow-moulding, laminating, joining, compression moulding, finishing.
	Wood	Turning, routing, spindle moulding, laminating, jointing, finishing, vacuum pressing/forming, steam bending.
	Composites	Benefits of composite materials. Carbon fibre, Kevlar based materials, glass reinforced plastics, engineered woods and materials, wood plastic composites,
Joining processes		Permanent, semi-permanent, temporary, adhesive bonding.
Identification of processes		Form, material, split lines, injection points, ejector points, shrinkage, draft angle, intricate form, clean and precise, flash, thinning of sheet material at corners, shear marks, cross-section over length, surface texture.
Production systems		One-off, batch, mass, line, flow. Gantt charts, flow charts, project planning, JIT, jigs, patterns, standard components, CAD/CAM, CNC machining. Quality control, quality assurance.
Functional analysis of products		Assembly methods, wall thicknesses, ribs, material testing.
Advances in materials and technology		Thermo-chromic pigments and films, phosphorescent pigments, shape

	memory alloys, piezoelectric devices, fibre optics, liquid crystal displays, genetic modification of woods, biodegradable plastics.
Production technology and scheduling processes	Benefits to designer of: CAD, CAM, CNC, stereo and technology lithography, 3D scanning, quick change injection moulding techniques, Quick Response Manufacturing (QRM), Electronic Point Of Sale (EPOS). Flexible Manufacturing Systems (FMS), miniaturisation.
Advances in communication	In supporting design activities, the uses and benefits of: e-mail, video conferencing, virtual reality, file sharing, mobile and touch screen interaction, storage, network access.
CAM processing	CNC = laser cutters and engravers, multi-axis routers and mills, plotter cutters, lathes, 3D printing, fusion deposition or stereo lithographic modelling. Additive and subtractive manufacturing/modelling.

Information for delivery of the Advanced Higher Design and Manufacture Course

Approaches to learning and teaching in the Course

The Advanced Higher Design and Manufacture Course is the natural progression from the Higher Design and Manufacture Course and allows learners to further develop their skills and knowledge while combining these with analytical and creative thinking to evaluate and design products. An understanding of design history and the ethical responsibilities of the designer must also be studied at this level. The Course is intended to be delivered through a wide and varied range of teaching and learning strategies in order that all learners can engage in interesting, exploratory, and experiential learning activities that encourage active learning.

The Advanced Higher Design and Manufacture Course consists of three Units — *Product Analysis*, *Product Development* and *Product Evolution* — and the Course assessment, which consists of a project and a question paper. The order in which the three Units are taught is not prescribed nor is how the centre chooses to approach the delivery of the Units — they can be delivered sequentially or concurrently with equal success and ease. It is for the centre to decide which will best support their learners in achieving their individual goals. Whatever approach is taken should not jeopardise the aims, intentions and essence of the Course. Professional knowledge of the learners and their needs may dictate specific avenues of approach, and careful planning partnered with strategic delivery will ensure that the learning experience will be as rich as possible.

The Course Specification gives details of mandatory skills, knowledge and understanding. At this level however, centres should not view these lists as definitive. Where centres have specific experience, expertise, equipment, materials and resources for additional or contemporary processes, then they are encouraged to make effective use of these to enhance and enrich the learners' experiences. Where the centre does not possess or have access to examples of the latest manufacturing technology, then use of multimedia and web-based resources can be effectively employed to demonstrate the operation and application of these technologies.

Centres are encouraged to pay close attention to the issues of ethics in design and sustainability. While emphasis is placed on environmental sustainability, the effects of social and economic accountability should not be overlooked nor should the ethical issues surrounding the decisions they make while designing products.

The Ellen MacArthur Foundation has a variety of useful resources for stimulating discussions and challenging the thoughts of the learners in this area. Visit <http://www.ellenmacarthurfoundation.org/education/secondary> for details.

Sequence of delivery

While there is no prescribed delivery sequence for Advanced Higher Design and Manufacture, centres should make a considered judgement as to which approach will best support the needs of their learners. At this level the learners may also be consulted as to their thoughts on how they would best like to see the Course delivered.

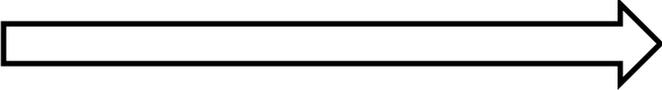
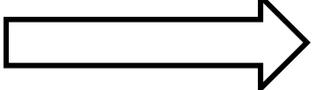
It is unlikely that the three Units could be integrated and centres are advised to encourage learners to tackle a range of different types of products while progressing through the three Units. This will lead to the learners having a broader range of experiences and provide them with a wider range of product types to refer to during the written paper of the final assessment.

The selection of products and scope of design tasks should be sufficiently 'open' to ensure that learners are required to make decisions on their own. Learners are likely to find tasks that have some relevance or personal meaning to them or to their community engaging and enjoyable.

Advice on distribution of time in the Course

Each Unit carries equal credit points but the needs of the learners and the centre will largely determine the allocation of time for each of the activities and experiences and hence the overall Unit duration.

Much of the learning will be self-directed and the teacher need assume the role of facilitator in many cases, making sure that the learners do not dwell too long on any one area. Careful consideration of the needs of each learner will allow the centre to plan how much time is required within each Unit. Where a concurrent model is used the year could be mapped out as follows:

	June	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Product Analysis	Analysis Tasks										
Product Evolution					Research Tasks						
Product Development	Design Tasks (Refer to <i>Unit Support Notes</i> for further details)							Consolidation			
Assessment											
									Exam preparation and Rework time for any outstanding Unit work		
											

Approaches to assessment over the Course

Additional information on Unit assessment approaches is given within each of the *Unit Specifications*.

The pace of Design and Manufacture is fast and it is imperative that centres keep close track of evidence trails for assessment purposes and ensure that rigour is not overtaken by pace. Learners should be encouraged to maintain clear, tidy folios which are supported by thoughts and notes where needed. However, rough sketches, sketch models, even short commentaries inform us about the learner's thinking and justify why decisions have been taken. These are very important and should not be unduly discarded as they will inform both the learner and the practitioner. This evidence will assist centres in determining exactly how the learner has arrived at their decisions, proposals, choices, approaches, methods and solutions. It is not necessary that each folio is a presentation piece in its entirety; the crucial evidence is to support thinking and learning.

Assessment activities, used to support learning, may usefully be blended with learning activities throughout the Course. Using an integrated approach to delivering the Outcomes of the Units should allow centres to combine a range of assessment techniques and ensure that it becomes a natural part of teaching and learning. The principles of formative assessment for the purposes of learning should be employed throughout learners' experiences on this Course.

The use of feedback, self- and peer-critique with regards to design ideas, concepts, solutions and practical activity will be invaluable to the learner's progress and understanding of the issues that will need to be resolved within the contexts of design and manufacture.

The use of appropriate assessment strategies will, in addition, support learning by:

- ◆ sharing learning intentions/success criteria
- ◆ using assessment information as a basis for directing learners to improve performance, and adapting teaching and learning activities appropriately
- ◆ boosting learners' confidence by providing supportive feedback

Teachers and lecturers are expected to prepare learners adequately for the Course assessment via their approaches to learning and teaching during the Units. Learners should be made aware of the expectations and standards required for success. The methods of preparation are left to the centre. Careful planning, timing, delivery and assessment methods should support each individual learner in achieving their goal. Centres should also apply more formal, timed activities to assess the readiness of the learner to undertake the Course assessment. Carefully structured home learning activities will also support this aim. Learners should be aware of their progress in learning, with clear strategies agreed to maximise their success.

Centres may design their own methods for recording evidence. The evidence must however be valid and prove that the learner's achievements are accurate and valid. The design of the Units should make the gathering of evidence a

natural activity. There will however be key points at which the centre will wish to focus on obtaining specific evidence as it contributes to the learner's progress.

The Course provides ample opportunity for learners to make effective use of ICT in learning, and assessment activities. There are many effective and established ways in which this can be done. Centres may wish to consider how technology and ICT could be used to support and record learners' progress in the Unit Outcomes or indeed to capture and present a picture of the learner's journey. Where materials are stored electronically, centres should ensure they are secure and backed up. In constructing folios, sketches, notes, images, screen capture and text may all be incorporated electronically if desired.

Preparation for Course assessment

Each Course has additional time that may be used at the discretion of the teacher or lecturer to enable learners to prepare for Course assessment. This time may be used near the start of the Course and at various points throughout the Course for consolidation and support. It may also be used for preparation for Unit assessment, and towards the end of the Course, for further integration, revision and preparation and/or gathering evidence for Course assessment.

Centres are free to consider how they will prepare learners to undertake the Course assessment to ensure that they will be as successful as possible. Although this will vary between centres, it is likely that learners will also have opportunities presented throughout the Unit activities to consolidate and prepare. For the Course assessment, time will be required for:

- ◆ preparation for the assignment, which could include considering exemplar assignments and practising the application and integration of skills
- ◆ carrying out the stages of the assignment, with teacher guidance and support
- ◆ assessing the design work and completed models or prototypes
- ◆ consolidation of learning
- ◆ development of problem solving skills
- ◆ preparation for the question paper

Combining assessment across Units

Due to the diverse nature of the three Units it is unlikely that the Units will be integrated at Advanced Higher level. However, if centres choose to integrate the Units and record evidence for assessment across Units care should be taken to ensure that the learners have not become one dimensional and had experience of a broad range of product types.

Where centres are using a themed or integrated approach to learning tasks and activities, it is likely that opportunities will arise to gather cross Unit assessment evidence, however, where many discrete activities are used, this is unlikely to be the case.

Information for delivery of the Product Analysis Unit

Approaches to learning and teaching in the Unit

This Unit provides the natural progression from the Product Analysis Unit at Higher level and is intended to be delivered through a wide and varied range of teaching and learning strategies in order that all learners can engage in interesting, exploratory, and experiential learning activities. The Unit contains three Outcomes that progress naturally from one to the other and easily allow the learner to further develop their own skills and knowledge through analysing products.

The *Course Assessment Specification* provides a list of mandatory content that should be covered within the Course. Where the Unit is being undertaken as part of the Course, there is ample opportunity to integrate the manufacturing topics into this learning for this Unit.

Extending the learning: personalisation and choice

Centres should take time to gather together a bank of low cost products to use in learning activities prior to the learners gathering evidence for the assessment. These products should show a range of joining and assembly methods, be made from a range of different materials and encompass a range of different functions and aesthetics. These products must be able to be completely stripped down and ultimately allow the learners access to the inner workings.

The more experience that learners have with a wide range of products, prior to the Unit and final assessment the more knowledge they will be able to draw upon for their assessment responses.

Centres should allow learners some degree of choice when selecting the product that they will analyse as part as learners are likely to find tasks that have relevance or personal meaning to them or to their community more engaging and enjoyable.

Sequence of delivery

While there is no prescribed delivery sequence for any Course or Unit, it is suggested that centres approach each of the three Outcomes within the Unit in order and allow the learners to gather evidence for the assessment as they progress through a series of short learning activities focusing on other products.

Typical delivery may look something like this:

Outcome 1: Analyse the performance of a commercial product

- 1.1 Evaluating the performance of selected commercial products*
- 1.2 Describing the operation and use of selected commercial products*
- 1.3 Commenting critically on the aesthetics of selected commercial products*
- 1.4 Commenting critically on the user interface of selected commercial products*

In teaching towards these Assessment Standards the teacher/lecturer may want to use group work to allow the learners to investigate the functional requirements

and operation of a variety of products. During this work the learners should record their decisions (possibly using spider diagrams) and discuss, with reasoned justification, what they feel the best method of evaluating these would be.

At this stage the teacher may need to reinforce/revisit the evaluation skills acquired from previous learning from the Higher Design and Manufacture Course. Particular attention should be taken to differentiate between objective and subjective questioning when developing evaluations and product tests. Learners should also be encouraged to develop thorough and appropriate product tests.

Groups should be encouraged to carry out quick user-trips of the products, not necessarily having to record their findings, just going through the process. The use of online survey designers such as SurveyMonkey or Google Forms could be encouraged to help develop, gather and collate information. Allowing group work will develop the learners' understanding of the importance of a range of opinions, and help develop and deepen their understanding of how to break down the function and operation into small, easily identifiable parts. Where group work is not possible due to class size, the learner can still go through the learning process with the teacher playing a more active role in the learning experience.

Once the learners have had time to experience these types of activities they should use their individual selected product for assessment and tackle Assessment Standards 1.1, 1.2 and 1.4 on their own, using their group work experience as a guide. It is likely that results will be presented in the form of graphs, tables, photographs and written text. It should be noted that the learning from these activities could provide a launch pad for the work required for Outcome 1 of the Product Evolution Unit.

Assessment Standard 1.3 requires the learner to comment critically on the aesthetics of products and again the learning for this may best be done through the use of group work, focusing on a range of the same type of product. The teacher should present a small range (possibly 3 or 4) of the same type of product to the group and ask the group to compare and contrast each of the products aesthetics. The group should be encouraged to consider how the use of different materials, colours, textures, weighting of the product, shape, line and balance affect the overall aesthetic of the products. This list should not be seen as definitive and centres are encouraged to add any appropriate factors that may influence the aesthetic of the product. Once the learning has taken place the learners should return to their chosen product and use their experience to comment critically on the aesthetic of the product. Where a range of products are not available, the use of the internet to access a range of products is permitted.

It is likely that results will be presented in the form of photographs and written text.

Outcome 2: Analyse the production of a commercial product

2.1 Identifying and investigating the materials and manufacturing choices made in relation to selected commercial products

- 2.2 *Describing assemblies and components and their purposes in terms of suitability and appropriateness for commercial production*
- 2.3 *Describing the design features in terms of suitability and appropriateness, Justifying the design choices made*

It is best to tackle this Outcome by first allowing learners to disassemble one or more products, then getting them to look carefully at how they are designed to fit together. Learners should be allowed to disassemble a product and record, using photographs any features they have identified that allow the product to be assembled, commenting where appropriate on the suitability. Centres may wish to use products from previous years as the focus of this learning activity. To complete the activity, learners should be encouraged to present their findings to their peers and discuss how the design of the products may have been influenced their production methods and assembly.

Once the learning has taken place, the Learners should fully disassemble their chosen product and record (by photographing) each step. These photographs can then be reordered and presented in such a way that the learner can describe the assembly and highlight any features, commenting on the suitability and appropriateness along the way. This can be used as evidence for Assessment Standards 2.2 and 2.3.

The last part of the Outcome requires the learners to identify the materials and manufacturing processes involved in the production of products. Once again the learning should focus on a range of different products that provide the opportunity to test and identify a range of different materials and manufacturing processes.

Much of the testing of plastics could be done in conjunction with the centre's chemistry department. These labs provide a safe environment for the full testing of the plastic materials; testing of metals, on the other hand, can easily be done in the practical workshop.

Centres may wish to prepare a range of known materials for the learners to test prior to the assessment. This can easily be done by removing small samples from known materials, keeping the identity of the material from the learners until the test have been completed.

A similar approach can be taken with the identification of the manufacturing processes. Centres should use a range of products to exemplify identifying features for a range of different manufacturing processes.

Once the learners are happy with the process of identifying the manufacturing process and testing of materials they should be allowed to complete the assessment for assessment standard 2.1. They should be encouraged to conduct tests on any materials that they cannot identify through visual tests. The evidence for this is best presented in the form of a table. Resources containing flow charts for materials testing can be found at on the 'consultekusa' website for plastics identification

As part of the evidence gathering process for the assessment of this Outcome the learners should disassemble their product recording each step using photographs. Care should be taken to make sure all functional testing and evaluation for the first Outcome has been carried out before this stage because once the product has been disassembled it is unlikely that it will be able to be returned to its original state. At this stage the centre should take care to ensure that all electrical products have their plug removed – they certainly must not be connected to the mains supply.

Outcome 3: Critically evaluate the impact of a product

3.1 Describing the impact of commercial products on society, economy, sustainability and the environment.

The final Outcome in the Unit draws together all the findings and also digs deeper into examining the impact products have on our daily lives. The learners must consider the product as a whole, looking in detail at each stage of a product's life to establish its impact.

The learner should consider whether or not the product changed or altered people's behaviour for the better. What difference did the product make on the local or global economy? Was sustainability considered not just in the design and manufacture of the product, but also after its intended useful life span? What effects did the product have on the environment, both globally and locally from its design, its manufacture and over its lifespan? Doing this will help the learners develop a fuller understanding of the role products play in our lives.

Much of the learning for this part of the Unit will revolve around initial research on the role products play in our society. Looking at The Ellen McArthur Foundation's online resources about the Circular Economy and the video resources on sustainable design from the 'classroom video' website will help enable the learners to develop a wider understanding of the impact products have on the world we live in.

Once learners have an appreciation and understanding of the wider issues they should be encouraged to look at the products they have studied and discuss the impact each product will have had at each stage of its life. If group work is not an option due to class size, then the teacher can play an active part in the learning. On completion, the learner should return to their chosen product and describe the impact that the product has had on society, the economy, sustainability and the environment at each stage of its life. It is expected that the evidence for this part of the Unit will consist of written text and possibly accompanying photo graphs.

Effective strategies for learning and teaching should be designed to support the Assessment Standards required from each Unit. These Assessment Standards can be found within each *Unit Specification*:

Information for delivery of Product Evolution Unit

Approaches to learning and teaching in the Unit

This Unit offered at Advanced Higher is a new area of study, but continues to build on the knowledge and skills gained from both Higher Design and Manufacture Units. Candidates will enhance their understanding of design issues and their role in the evolution of commercial products through the analysis of products from the past, present and future. The work in this Unit should not be seen as a discrete, but used to supplement and enhance the work undertaken in other Units.

The work in this Unit should be delivered through a wide and varied range of teaching and learning strategies in order that all candidates can engage in interesting, exploratory and experiential learning activities.

The Unit contains two Outcomes which focus on the impact materials, technology, society and the environment have on the evolution of products.

Outcome 1 allows the learner to develop a broad understanding of what drives the evolution of products by considering the external issues that afford designers the opportunity to develop and improve products. Learners should be encouraged to analyse how new materials and advances in manufacturing technologies have contributed to the evolution of different product types. This Outcome should involve both a reflective study of the past and consideration as to how advances in materials and technology will impact on the future development of products. The learner will also be required to analyse how society continues to influence the design of products, together with the pressure environmental concerns will apply to the future development and evolution of products. Learners should also consider the positive and negative impact product design has had on the developed and developing world.

Outcome 2 is a more focused study and draws directly from the knowledge and understanding from Outcome 1. In this Outcome the learner is required to focus on the development of a product or product type, tracing its development from introduction on to the market to the present day. The learner will be required to identify major changes in the appearance, performance and popularity of a selected product and provide informed opinions as to what made the changes possible and the impact of the changes made. Learners should be encouraged to consider more than the obvious visual changes to the aesthetics of a product and consider a wide range of design issues that will have developed in a product, including economic and environmental issues.

The *Course Assessment Specification* provides a list of mandatory content that should be covered in the Course. Where the Unit is being undertaken as part of the Course, there is ample opportunity to integrate the manufacturing topics into this learning for this Unit.

Extending the learning: personalisation and choice

It is important that centres ensure that candidates have access to a wide range of source material for appropriate research and effective analysis. This should include web links, books, articles, journals and, if possible, a bank of products that reflect product evolution for analysis and identification. Candidates should also be encouraged to undertake field trips and visits to obtain information first hand.

It is essential that candidates undertake a wide range of activities that allow them to identify and analyse how products are influenced by materials, technology, society and the environment. This Unit should be seen as a source of knowledge that helps consolidate the candidates' understanding of design issues and provides information required for the external exam.

It is important that candidates gain experience and a degree of competence in researching and obtaining valid and appropriate research, undertaking more than just internet searches for archive information. The focus should be on the influence, stimulus and impact of evolution and development. Gaining knowledge from a wide range of products will extend the candidates' learning, provide a good knowledge-base for both Unit and external assessment, and provide more opportunity for personalisation and choice.

Centres should allow learners some degree of freedom as to how they are going to explore the evolution and development of products, and how they will present their findings. Selecting an area of study in which they have a genuine interest will increase the relevance of the activity and make the experience more engaging and enjoyable.

Sequence of delivery

While there is no prescribed sequence of delivery for any Course or Unit, it is suggested that centres approach each of the two Outcomes in the Unit in order. This will allow candidates to gather and present information relating to the development of products that will aid and inform the work required in the second Unit. It is important to gather and record information that can be used for assessment as the candidate progresses through the Unit.

Typical delivery may look something like this:

Outcome 1: *Investigate, describe and explain the key factors which influence the design, development and manufacture of commercial products by:*

- 1.1 *Investigating the influence of materials and manufacturing technologies on the development of products*
- 1.2 *Describing and evaluating the external factors which influence the design and development of commercial products, including those which are socio-economic and environmental*

In teaching toward these Assessment Standards it is important that the teacher provides the candidates with a range of activities that can be used to appreciate the influence materials and manufacturing have and will continue to have on

design issues such as aesthetics, function, safety, durability, cost, availability, maintenance and sustainability.

It is important that the learning in this Unit is not derived solely from secondary research and distilled to archive material from internet searches. Candidates should be encouraged to consider and analyse existing products to develop their own understanding as to the influence of materials and manufacturing technologies. A natural starting point for this could come from the learning obtained from the Product Analysis Unit Outcome 2. This will help candidates identify how materials have been used and how manufacturing technologies have influenced all stages of the design process.

Teachers should introduce the candidate to examine a range of different products, and encourage peer discussion about the influence materials and technologies have had on all aspects of the design process. Candidates should begin to appreciate the close interrelationship between materials, manufacture and the performance of a product.

When candidates have become confident in identifying materials and manufacture through first hand experiences, and have recorded informed opinions as to how they have influenced products, they can begin to investigate a wider range of materials and manufacturing technologies. Centres may want to provide some guidance at this point to ensure candidates are going to follow a suitable line of investigation. Provision of basic timelines on the evolution of materials, production methods, processes and manufacturing systems could help guide candidates and improve the learning experience.

Candidates should be given the opportunity to develop basic timelines into a more detailed and informative body of work. Candidates should also be encouraged to identify products that could be used to exemplify changes due to materials and manufacturing technologies and be able to explain the changes. As candidates begin their own research into products and how they have developed through materials and manufacture, their investigation will begin to suggest other issues also influencing the development of products. Other simple timelines relating to social change, economics legislation and the environment could be supplied and used to identify changes and developments to commercial products. This information could be recorded in a personal journal, detailed timelines, annotated images or educational posters. Use of ICT should be considered, as it could enhance the learning experience and provide good quality graphics material as evidence for this Outcome.

Outcome 2: Investigate the influences on the evolution of a selected commercial product over time by

2.1 Describing the evolution of a selected commercial product

2.2 Explaining and justifying the key influences of change

2.3 Evaluating the impact of the design changes to the product's success

This Outcome could be approached as a separate activity, or could be incorporated into the work undertaken in Outcome 1.

Outcome 2 is a much more focused investigation, and should provide the candidate with more detailed and specific information about a single commercial product. It is important that the candidate is given the opportunity to select a product that holds some personal interest. However, some teacher guidance may be required to ensure the product has the capacity to address all the requirements of Outcome 2. Suitable products should have a long history of evolution and have undergone a wide range of changes some of which are obvious and explicit, and some more subtle and oblique.

Before attempting this Outcome it is important to spend some time ensuring candidates have suitable research and investigation skills. Visiting museums and libraries can provide a good starting point for this Unit. The school librarian could also be good source of information and help when beginning an investigation. Research and investigation techniques should be used to make efficient and effective use of time and resources. Internet searches are not always productive and are frequently inefficient. Take some time to assess the candidates' abilities to use the internet, and provide some basic instruction as to how to use different search engines and websites. Using modifiers when doing an internet search will help refine a search and provide better information ie:

- ◆ search for an exact phrase by using quotation marks
- ◆ use the negative sign to exclude words
- ◆ inserting ~ before a word will search for similar words to the one you typed
- ◆ use numerical ranges to search between specific dates

Scran is a good site for providing visual images that are catalogued in a similar style to a museum, which can provide very specific information about individual products. Encourage candidates to record all sources of information and web links to allow them to re-visit information when necessary.

There are a number of approaches that could be taken to address this Outcome. The approach or combination of approaches used will depend on the centre and the candidate:

- ◆ Use research to identify an example of a chosen product from each decade in the last century. Identify the external influences that influenced changes to the product and describe how they influenced the product's evolution.
- ◆ Select a product and find examples from each of the prominent design movements of the last century. Research the influences, beliefs and ideologies of each design movements and use this information to describe the changes and evolution of the chosen product.
- ◆ Identify prominent designers from the last century. Research the influences, beliefs and ideologies of each designer and use this information to describe the changes and evolution of the chosen product.

This information could be recorded in a personal journal, detailed timelines, annotated images or educational posters. Use of ICT should be considered as it could enhance the learning experience and provide good quality graphics material as evidence for assessment.

Effective strategies for learning and teaching should be designed to support the Assessment Standards required from each Unit. These Assessment Standards can be found within each *Unit Specification*.

Information for delivery of Product Development Unit

Approaches to learning and teaching in the Unit

This Unit also draws on the knowledge gained in the Product Analysis Unit at Advanced Higher level. The teaching and learning strategies employed should be varied and diverse in order that all learners can engage in interesting, exploratory, and experiential learning activities.

The Unit contains three Outcomes that progress naturally and allow the learner to further develop their design and visualisation skills. The Unit can be used to take the learner through the whole design process with assessment derived from the learner response to their own research, brief and specification. However there is no requirement to combine all Outcomes and approach them in order. Adopting a more focused and pupil-centred approach considering different activities to suit the learning and teaching for each Unit could provide a more varied and informative experience for both the teacher and learner.

The *Course Assessment Specification* provides a list of mandatory content that should be covered in the Course. Where the Unit is being undertaken as part of the Course, there is ample opportunity to integrate the manufacturing topics into this learning for this Unit.

Extending the learning: personalisation and choice

Centres should allow learners some degree of freedom of choice when selecting the product or problem area that they will focus on as part of the assessment, as they are likely to find tasks that have some relevance or personal meaning to them or to their community more engaging and enjoyable.

However, it is important that when centres select products or focus-issues for the learning activities in the build-up to the assessment they cover a range of design issues and product types. This will help further equip learners for their final written assessment, which is likely to ask them to draw on their experience of products and design experience.

Sequence of delivery

While there is no prescribed sequence of delivery for any Course or Unit, it is suggested that centres approach the learning and teaching required for this Unit through a series of small-scale design projects before allowing the learners to draw together all of their experiences and gather evidence from across all of the projects for assessment.

Setting different design challenges to addressing different Unit Outcomes provides a clear structure to the Unit and allows both teacher and learner to monitor and track their progress. Breaking down the design process into smaller

parts may improve the learners' understanding by allowing the teacher and learner to focus on specific skills and knowledge required when considering different stages of the design process.

An emphasis on presentation and communication skills should be at the centre of each mini-project, as this will allow skills to develop naturally and be enhanced through time based on the task, quality feedback and contextualisation. However, the type of presentation and range of communication skills uses should be appropriate to the design task and stage of the design process being addressed.

Delivering this Unit through a series of mini-projects should provide more teaching opportunities and allow both the teacher and learner to focus on different parts of the design process. Approaching the Unit in this way should help identify specific skills and knowledge required at each stage of the design process, from the identification of design opportunities and generating initial ideas to developing, presenting and evaluating design proposals. This focused approach should provide more opportunities for the learner to enhance their own skills, knowledge and understanding required at specific stages of the design process. These smaller projects should also avoid unnecessary repetition and provide the learner with more opportunities to identify strengths and weaknesses in their own work, widen the context of learning and provide a more enjoyable pupil-centred learning environment.

Typical delivery may look something like this:

Project One

It may be useful to set a project at the beginning of the Course to identify the difference between Higher and Advanced higher. Setting a project that could be used to enhance the learners' skills in communication, using research, testing and evaluating design ideas and designing for manufacture will provide a good foundation of knowledge on which to build throughout the Course. An example of a suitable project is outlined below.

Supply learners with a brief and specification for a simple hand held product. A torch is a good product type as it is easy to analyse and understand. It is important that the product selected offers the learner the potential to produce a range of ideas and develop one to a detailed finished design efficiently and in a short period of time.

This project should be led by the teacher and should be used to demonstrate the difference between Higher and Advanced Higher. Opportunities to explore effective research and how it is applied in the design process offer a good starting point for this project. Candidates should be guided through a user trip and methods of presentation should be demonstrated.

The depth of knowledge and design detailing required at this level can be addressed through a thorough analysis of the product, focusing on the influence of materials and manufacturing technologies on the aesthetics and performance of the product, internal design detailing, operation and method of assembly.

Define a clear target market to drive the aesthetic direction of the product. Using imagery from lifestyle boards offers a useful way of generation ideas and gaining a deeper understanding of aesthetics.

Learners should be encouraged to generate ideas quickly and may benefit from teacher input on appropriate idea generation techniques – 2D sketching and quick block modelling are effective ways of recording ideas, and also provide a good platform to enhance communication skills. Using modelling to refine ideas with a focus on ergonomics provides the learner with good-quality feedback and reinforces the need to change and adapt a design during its development and synthesis.

Introducing limitations such as designing around standard components, internal design features (discovered through analysis) generates a more mature and detailed response. This also reflects the issues and influences faced by professionals in the commercial design industry. Computer models can be used to explore and refine ideas as well as provide quality presentation drawings and models. Many packages also contain features to explore design for manufacture, giving more feedback than is possible with simple pencil sketches.

Project Two

Develop an existing design proposal towards its commercial manufacture. This forces the candidate away from restyling and focuses their attentions on the influence of materials and manufacturing technologies. This should involve a considered development and synthesis and encourage the candidate to make fine adjustments and alterations to their design work.

Using a Higher project from a previous year offers a good starting point as it helps identify the differences between Higher and Advanced Higher. Using an existing design allows the learner to focus on the synthesis required for commercial manufacture and provides more opportunities to enhance their understanding of design issues influencing a successful commercial product beyond superficial restyling.

Project Three

Design for the environment, considering different approaches to green design and sustainability. Learners could be provided with a design brief that requires an existing product to be redesigned to reduce its impact on the environment. The project should encourage the learner to explore and analyse a number of different approaches, ranging from specifying different materials and using different manufacturing systems to radical redesigns considering sustainability, recycling and reuse.

These three projects may focus on:

Outcome 2: Develop, synthesise and evaluate a range of product design concepts

2.1 Developing a range of concepts towards a design proposal

2.2 Synthesising a range of concepts into a design proposal

2.3 Evaluating and justifying a design proposal against a design specification

2.4 *Analysing the design proposals and decisions in terms of their broad ethical, social, economic and environmental impacts*

Outcome 3: Present concepts and proposals using a range of visualisation techniques

3.1 *Selecting and applying appropriate visualisation techniques to communicate ideas, concepts, development and design thinking*

3.2 *Collating and presenting visualisations in an effective format*

Project Four

Designing for a company. This provides the candidate with a number of constraints relating to materials, aesthetics, construction, philosophy and economics. Learners could be provided with a design task that requires them to focus on an established company and undertake suitable research to establish a design brief and specification to provide an outline proposal for a new product to complement the company's existing product range.

Project Five

Using learners' design skills with the aim of improving their own environment through a live project. Encourage learners to use their design skills to identify and develop a design for their own school environment. Economic constraints, manufacturing strictures, impact on the environment, limitations of the target market and contribution to society are all issues that are likely to drive this type of project, moving the design process away from simple shaping and restyling.

Project Six

Redesign for a niche market. Provide the learner with a design task highlighting an existing product and an end user who has very particular needs and requirements that make use and interaction difficult. Typical market groups and products that could be used to encourage detailed analysis and research into design factors leading to a brief and comprehensive specification could be:

- ◆ making existing products more child-friendly
- ◆ making the high-tech world more accessible to the elderly
- ◆ redesigning existing products for extreme conditions and environments
- ◆ develop alternative solutions to match the need of people with disabilities

Basing the project around existing products creates more opportunity for primary research activities such as user trips, trials, comparative studies and surveys providing the learner with more meaningful learning activities.

These three projects may focus on:

Outcome 1: Identify opportunities for commercial product development

1.1 *Identifying the factors which present a product development opportunity*

1.2 *Producing a brief for a product development proposal*

1.3 *Compiling a comprehensive design specification*

Effective strategies for learning and teaching should be designed to support the Assessment Standards required from each Unit. These Assessment Standards can be found within each *Unit Specification*.

Appendix 2: Reference documents

The following reference documents will provide useful information and background.

- ◆ Assessment Arrangements (for disabled candidates and/or those with additional support needs) — various publications are available on SQA's website at: www.sqa.org.uk/sqa//14977.html.
- ◆ Building the Curriculum 4: Skills for Learning, Skills for Life and Skills for Work
- ◆ Building the Curriculum 5: A Framework for Assessment
- ◆ [Course Specifications](#)
- ◆ [Design Principles for National Courses](#)
- ◆ [Guide to Assessment](#)
- ◆ [Overview of Qualification Reports](#)
- ◆ Principles and practice papers for curriculum areas
- ◆ [SCQF Handbook: User Guide](#) and [SCQF level descriptors](#)
- ◆ [SQA Skills Framework: Skills for Learning, Skills for Life and Skills for Work](#)
- ◆ [Skills for Learning, Skills for Life and Skills for Work: Using the Curriculum Tool](#)
- ◆ [Coursework Authenticity: A Guide for Teachers and Lecturers](#)

Administrative information

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History of changes to Advanced Higher draft Course/Unit Support Notes

Course details	Version	Description of change	Authorised by	Date

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