SQA Advanced Unit specification

General information

Unit title: CAD: 3D Printing and Scanning (SCQF level 7)

Unit code: HV1L 47

Superclass: CC

Publication date: June 2018

Source: Scottish Qualifications Authority

Version: 02

Unit purpose

This Unit is designed to introduce learners to 3D printing and scanning technologies enabling practical exploration of both. The Unit will provide learners with an understanding of comparable methods for each technology.

This Unit is suitable for learners seeking to develop an understanding of CAD, Design and Manufacturing approaches for any industry.

Outcomes

On successful completion of the Unit the learner will be able to:

1 Evaluate and document the practical application of 3D printing and scanning technologies.
2 Use current 3D scanning technologies.
3 Repair and manipulate 3D scan geometry in preparation for 3D printing.
4 Use current 3D printing technologies.

Credit points and level

1 SQA Credit at SCQF level 7: (8 SCQF credit points at SCQF level 7)

Recommended entry to the Unit

Access to this Unit is at the discretion of the centre. However, it is recommended that learners have a basic knowledge of IT file handling and an understanding of 2D CAD and 3D CAD prior to undertaking this Unit. Knowledge and understanding might be evidenced by the possession of appropriate Units at SQA Advanced level, eg HR3L 47 CAD: 2D I, HR3H 47 CAD: 2D II, HV1K 47 CAD: 3D Surface and Solid Modelling and HR7H 47 CAD: User Systems.

Core Skills

Opportunities to develop aspects of Core Skills are highlighted in the Support Notes for this Unit specification.

There is no automatic certification of Core Skills or Core Skill components in this Unit.

Context for delivery

If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

The Assessment Support Pack (ASP) for this Unit provides assessment and marking guidelines that exemplify the national standard for achievement. It is a valid, reliable and practicable assessment. Centres wishing to develop their own assessments should refer to the ASP to ensure a comparable standard. A list of existing ASPs is available to download from SQA's website **(http://www.sqa.org.uk/sqa/46233.2769.html)**.

Equality and inclusion

This Unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website **www.sqa.org.uk/assessmentarrangements**.

SQA Advanced Unit specification: Statement of standards

Unit title: CAD: 3D Printing and Scanning (SCQF level 7)

Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

Outcome 1

Evaluate and document the practical application of 3D printing and scanning technologies.

Knowledge and/or Skills

- Advantages and disadvantages of current 3D scanning and printing technologies
- Creation of ongoing recordings of the use of 3D printing and scanning technologies
- Creation of cost estimates of processes undertaken when using 3D printing and scanning technologies
- Consideration of issues arising when mass producing using 3D printing technologies

Outcome 2

Use current 3D scanning technologies.

Knowledge and/or Skills

- Produce 3D digital model by use of current 3D scanning technology
- File management and preparation of scanned 3D model in preparation for manipulation

Outcome 3

Repair and manipulate 3D scan geometry in preparation for 3D printing.

Knowledge and/or Skills

- Repair and solve any geometric errors in geometry created by scanning method
- Modification of 3D scanned model
- Preparation of model and file for 3D printing

Outcome 4

Use current 3D printing technologies.

Knowledge and/or Skills

- Further prepare 3D model to counter any disadvantages of chosen 3D printing method
- Realise physical 3D model by use of chosen 3D printing method

Evidence Requirements for this Unit

Learners will need to provide written and/or oral recorded and product based evidence to demonstrate their Knowledge and/or Skills across all Outcomes by showing that they can:

- produce written and/or oral recorded evidence documenting the processes undertaken, with analysis of the available 3D scanning and 3D printing technologies available at the time of delivery.
- produce cost estimate of the processes undertaken.
- produce written and/or oral recorded evidence providing consideration of issues arising when mass producing using 3D printing technologies.
- produce a 3D digital model by means of 3D scanning technology.
- produce a modified version of the 3D scanned model according to direction.
- produce a realised 3D physical model of the modified subject by means of 3D printing technologies.

Due to the emulation of a project based working environment this Unit could be integrated. Outcomes 1–4 could be assessed as one complete project. However the Unit can be delivered in order with Outcome 1 being worked on continuously throughout Outcomes 2–4 at the discretion of the centre.

Assessments should place emphasis on documentation within Outcome 1 of all events, transitions and occurrences during the undertaking of the Unit. Assessments should be conducted under open-book conditions with access to any resource or materials, however use of the centre based equipment should be supervised to ensure health and safety and proper care is taken.

The Unit is a project based learning approach and therefore learners need to complete all four Outcomes within the 40 hours allocated to deliver the Unit. There is no individual time constraint for each stage so long as the overall project is completed.

It should be noted that learners must achieve all the minimum evidence specified for each Outcome in order to pass the Unit.

SQA Advanced Unit Support Notes

Unit title: CAD: 3D Printing and Scanning (SCQF level 7)

Unit Support Notes are offered as guidance and are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this Unit

As the Unit is intended to emulate a project within a working environment, the context of delivery should reflect the demand for these technologies in industry local to or partnered with the centre. Outcomes 1–4 should be assessed as one complete project.

Outcome 1

- Advantages and disadvantages: comparison between different 3D Printing and Scanning technologies should be researched and recorded. For 3D printing this could include comparison on speed, accuracy, material type, build volume, support material, colour capability, operating cost and capital costs.
- Process cost for 3D scanning and printing of specific artefact, this could include time management, 3D scanning preparation and process, manipulation and processing of 3D scanned data, 3D printing preparation and process, post production process, material use and wastage and basic overheads.
- Issues for consideration when mass producing using 3D printing technologies: this could include consideration of bed size for nesting of artefacts, overheads, material use and wastage, support material other resources including physical space.

Outcomes 2–4 abstract ideas for context include:

- Scanning, and digital restoration of a decayed artefact or section of a historical building. With 3D printing intended to produce replicas of the original to preserve its form.
- Scanning, and modification of an engineering design element with 3D printing to be used to mass produce the new modified element.
- Scanning of a popular product with the intention of making modifications to create a similar but new legal alternative product.
- Outward scanning of an interior environment about to undertake a style overhaul. Making the desired design changes adding new furniture and 3D printing a model.

The Unit may form part of a group award or be completed as a free-standing Unit. The Unit will allow learners to take their expertise into industry or even encourage the entrepreneurial opportunities these technologies can offer. The Unit will aid progression to SQA Advanced Diploma Year 2 of the CADD Group Award and in particular with *CAD: Prototyping and Computer Aided Draughting and Design*: Graded Unit 2.

Guidance on approaches to delivery of this Unit

This Unit would work very well with learners working in groups especially when investigating the variety of technologies available and discussing the advantages and disadvantages. However, it is important to ensure each individual learner produces sufficient evidence the meet the Evidence Requirements in this Unit. At the discretion of the delivering centre, the Unit can be undertaken individually by learners.

The Unit is intended to emulate a working environment so the delivering lecturer can choose to either act as the mentor/guide or manager of the leaners undertaking the Unit, allowing opportunity to emulate working conditions, hours and rules if desired.

Due to the emulation of a project based working environment this Unit could be integrated. Outcomes 1–4 could be assessed as one complete project. However the Unit can be delivered in order with Outcome 1 being worked on continuously throughout Outcomes 2–4 at the discretion of the centre.

Guidance on approaches to assessment of this Unit

Evidence can be generated using different types of assessment. The following are suggestions only. There may be other methods that would be more suitable to learners.

Centres are reminded that prior verification of centre-devised assessments would help to ensure that the national standard is being met. Where learners experience a range of assessment methods, this helps them to develop different skills that should be transferable to work or further and higher education.

A 3D printer and 3D scanner will be required to meet the Evidence Requirements of the Unit. However the calibre of each technology used is not specified. That said, the technology available at the centre should reflect something the learners could not acquire themselves and reflect as best as possible something usable in industry.

Assessments should be conducted under open-book conditions with access to any resources and materials to reflect a project based approach. No individual time limits are present for each Outcome, only that learners must complete all Outcomes in the Unit by the end of delivery.

Assessments may be delivered to groups or individuals as long as each individual learner produces sufficient evidence to meet the Evidence Requirements.

Assessment should place emphasis upon documentation of unexpected occurrences during the practical use of each technology and during file importing/exporting transitions. This will allow learners/groups to fully explore the less obvious hurdles that need to be overcome when utilising these technologies. This comparative data could then be shared and discussed with the entire class at the end. This creates opportunity for an optional post-assessment session that will greatly improve the learners' general understanding of the technology investigated by allowing them insight into multiple attempts at the project.

It is recommended that the following evidence is retained:

- Computer files (3D Scan, original, repaired and modified separately).
- Hard copy print out/digital PDF document or oral alternative for Outcome 1.
- Physical 3D printed models including any failed attempts.

During the practical activities, staff observation is advised to help authenticate work produced. In addition, centres may choose to employ the use of a student signed statement of authenticity.

Opportunities for e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by Information and Communication Technology (ICT), such as e-testing or the use of e-portfolios or social software. Centres which wish to use e-assessment must ensure that the national standard is applied to all learner evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at **www.sqa.org.uk/e-assessment**.

Opportunities for developing Core and other essential skills

Learners will have opportunities to develop the Core Skills of *Numeracy*, *Communication*, *Working with Others* and *Problem Solving* at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Numeracy — *Numeracy* skills will be developed as learners are required to generate costing estimates. Learners will have to work with complex 3D geometric models, this will utilise an understanding of geometric math and coordinate systems, regularly requiring arithmetic skills to make adjustments.

Problem Solving — CAD use is continuous problem solving in itself. Learners will also need to analyse various 3D scanning and printing technologies and weight up the value of each. The software used will commonly bring forth errors or unexpected results that learners will have to find methods of either working around or solving directly.

Communication and Working with Others — The Unit is designed to work very well with others and the lecturer delivering can act if desired as a boss/manager/mentor, enabling learners to interact with a managerial role. Opportunities exist while working on the production of the report, cost estimates and final preparation of written and/or oral evidence for Outcome 1. Further to this opportunities exist for learners to work collaboratively on Outcomes 2–4

In addition to Core Skills, as the Unit is intended to be delivered to emulate a working environment as project based learning, learners will have the opportunity to develop citizenship and employability skills**.**

History of changes to Unit

Version	Description of change	Date
02	Superclass changed from VF to CC	June 2018

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of SQA Advanced Qualifications.

FURTHER INFORMATION: Call SQA's Customer Contact Centre on 44 (0) 141 500 5030 or 0345 279 1000. Alternatively, complete our Centre Feedback Form.

General information for learners

Unit title: CAD: 3D Printing and Scanning (SCQF level 7)

This section will help you decide whether this is the Unit for you by explaining what the Unit is about, what you should know or be able to do before you start, what you will need to do during the Unit and opportunities for further learning and employment.

The Unit will enable you to develop a knowledge and understanding of the operation of 3D printing and 3D scanning technologies and follow a practical project that will allow you to get hands-on experience with each technology. The Unit will allow you to explore the uses of these technologies in industry and potentially at home.

This Unit is suitable if you have moderate experience with CAD software packages, with an understanding of both 2D and 3D elements. The Unit forms part of a Group Award designed to provide learners with technical and professional knowledge of CAD software, Design and Manufacturing processes. It may also be completed as a free-standing Unit.

Due to the emulation of a project based working environment this Unit could be taken in order with Outcome 1 being worked on while you are working on Outcomes 2–4. Outcomes 1–4 may be assessed as one complete project.

The principal aims of the Unit are to:

- prepare learners for employment or further education in CAD fields and Industries utilising 3D printing/scanning.
- provide learners with expertise with each technology.
- explore the various methods of 3D printing/scanning current to time of delivery.
- enable learners to become accustomed to documenting design activity and become comfortable with producing cost estimations and evaluations.

There are opportunities to develop the Core Skills *Numeracy*, *Communication*, *Working with Others* and *Problem Solving* at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components. In addition to Core Skills, there may be opportunities to develop citizenship and employability skills.