

SQA Advanced Unit Specification

General information for centres

Unit title: Simulation of Advanced Manufacturing Systems

Unit code: HV57 48

Unit purpose: This unit has been designed to allow candidates to develop the knowledge and skills to describe, design and test a simulation model of a manufacturing system.

On completion of the unit the candidate should be able to:

- 1 describe and compare advanced manufacturing systems
- 2 create a simulated model of a manufacturing system
- 3 problem solve for a practical application using simulation tool(s)

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

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from National 1 to Doctorates.*

Recommended prior knowledge and skills: Candidates should have knowledge and understanding of the major components required to build a manufacturing model. This may be evidenced by possession of the following SQA Advanced Units: Production Planning and Control, Manual and Automatic Assembly Systems.

Knowledge, understanding and skills of modelling manufacturing systems acquired as a result of employment experience may be sufficient to allow direct access to this unit.

Core skills: There may be opportunities to gather evidence towards the following listed core skills components in this unit, although there is no automatic certification of core skills or core skills components.

Reading Communication	SCQF level 6
Written Communication	SCQF level 6
Using Information Technology	SCQF level 6
Critical Evaluation	SCQF level 6
Planning and Organisation	SCQF level 6
Reviewing and Evaluation	SCQF level 6

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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.

Assessment: Outcome 1 should be assessed using one single assessment paper taken at a single assessment event that should last no more than one hour. This assessment should be conducted under supervised, controlled conditions.

Outcomes 2 and 3 should be combined into one practical assignment covering all of the knowledge and/or skills items in both outcomes. The practical assignment should be assessed under open-book conditions. In Outcome 2, candidates will be asked to build a simulation model representing a manufacturing system. In Outcome 3, candidates will be asked to problem solve using the model created in Outcome 2 or on a model from their own field of experience. Candidates should provide evidence in the form of a written report plus other relevant documentation based on a format devised by the centre together with the manufacturing system model which should be witnessed and/or in an electronic format. Centres should devise checklists in order to assess all candidate evidence.

SQA Advanced Unit Specification: statement of standards

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The sections of the unit stating the outcomes, knowledge and/or skills, and evidence requirements are mandatory.

Where evidence for outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Describe and compare advanced manufacturing systems

Knowledge and/or skills

- ◆ Manufacturing Functions
- ◆ Information processing
- ◆ Flexible Manufacturing Systems (FMS)
- ◆ Automated Guided Vehicles (AGVs)
- ◆ Sensory devices
- ◆ Single Minute Exchange of Dies (SMED)
- ◆ Group Technology

Evidence requirements

Evidence for the knowledge and/or skills in this outcome will be provided on a sample basis. The evidence may be presented in response to specific questions. Each candidate will need to demonstrate that they can answer questions based on a sample of the items shown above. In any assessment of this Outcome **five out of seven** knowledge and/or skills items should be sampled.

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of five out of seven knowledge and/or skills items is required each time the outcome is assessed.

Where sampling takes place, a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ draw a block or process diagram itemising the process steps for conversion of raw material into finished products
- ◆ state modern information processing functions required in a manufacturing system
- ◆ explain FMS model with reference to the basic system components
- ◆ explain the operation and function of AGVs including itemising at least three pros and three cons
- ◆ describe two sensory devices used in modern manufacturing systems
- ◆ state the benefits of SMED approaches to tool design for flexible manufacturing
- ◆ state group technology principles

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This outcome should be assessed by means of one single assessment paper taken at a single assessment event that should last no more than one hour. Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under closed-book conditions and as such candidates must not be allowed to bring any textbooks, handouts or notes to the assessment.

Assessment guidelines

The assessment paper could comprise a balance of short-answer, multiple-choice and restricted-response questions.

Outcome 2

Create a simulated model of a manufacturing system

Knowledge and/or skills

- ◆ Discrete event simulation
- ◆ Simulation modelling
- ◆ Optimum operating criteria

Outcome 3

Problem solve for a practical application using simulation tool(s)

Knowledge and/or skills

- ◆ Manufacturing model analysis
- ◆ Model controls
- ◆ Model experiments
- ◆ Model results
- ◆ Model development

Evidence requirements

Both Outcomes 2 and 3 are practically based and **all** of the knowledge and/or skills items should be assessed. Evidence for both outcomes should be presented in response to a practical assignment in which the candidate is set the task of producing and testing a model of a manufacturing system using appropriate software assistance.

For Outcome 2, a candidate's response can be judged to be satisfactory where the evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ report on the benefits of discrete event simulation of a manufacturing system
- ◆ create a simulated model for a manufacturing system
- ◆ validate operating parameters for a manufacturing system

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For Outcome 3, a candidate's response can be judged to be satisfactory where the evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ analyse an existing manufacturing model
- ◆ evaluate and control the simulation
- ◆ devise two experiments to run on the model
- ◆ interpret results
- ◆ make recommended improvements to achieve the agreed specification

Candidates should provide evidence in the form of a written report plus other relevant documentation based on a format devised by the centre together with the manufacturing system model which should be witnessed and/or in an electronic format. Centres should devise checklists in order to assess all candidate evidence.

Assessment guidelines

Manufacturing models that could be developed could include component manufacture and/or assembly systems, production control systems or other manufacturing systems. It is normally expected that for Outcome 3 candidates will use the model built for Outcome 2 although candidates may also use another model based on their own field of experience to satisfy the assessment requirements of Outcome 3.

The final report format may be as shown below:

- 1 Introduction to Simulation
- 2 Real World problem
- 3 Paper Model
- 4 Software Build
- 5 Validation Approach
- 6 Experiments and Test
- 7 Results
- 8 Recommendations
- 9 Appendices

Appendices content

- ◆ Model Build
- ◆ Obtaining confidence limits
- ◆ Prioritising resources
- ◆ Attributes
- ◆ Interruptions (scheduled and unexpected)
- ◆ Use of Simul8, Excel Spreadsheet
- ◆ System report could include utilisation, production, status and tool reports

Centres may wish to use oral questioning to confirm a candidate's knowledge and understanding of an area(s) of the report that is not clear as a result of marking the report. A checklist may be developed to support this oral questioning.

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Administrative Information

Unit code:	HV57 48
Unit title:	Simulation of Advanced Manufacturing Systems
Superclass category:	VE
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SQA Advanced Unit Specification: support notes

Unit title: Simulation of Advanced Manufacturing Systems

This part of the unit specification is offered as guidance. The support notes 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

This unit provides a solid basis for which candidates can acquire knowledge and skills in the benchmarking, software model creation and analysis of a manufacturing system. Unit content and context should be set around a system that is familiar to both candidates and lecturing staff involved. The unit can be run with the co-operation of a local company interested in simulating part, or all, of its manufacturing system.

In Outcome 1 a general overview of a manufacturing system should be carried out with particular respect paid to information systems. Work envelope should be explained to candidates with reference to Flexible Manufacturing Systems together with general purpose Automated Guided Vehicles (AGVs) and at least two sensory devices associated with FMS. Sensory devices should be from a broad range, mechanical, electronic, air operated. It is anticipated that delivery of Single Minute Exchange of Dies (SMED) and Group Technology principles will be delivered together as a lean manufacturing theme. Families of part classification should be related to possible die design advantages.

Outcomes 2 and 3 should be combined to form one assessment exercise in order to meet all requirements within both knowledge and skills statements. It is anticipated that the candidate will use a commercially available simulation software package in order to fulfil the requirements, eg Simul8, Microsoft Excel. The complexity of the manufacturing system is left to the discretion of the centre. However, the model should be sufficiently complex to ensure that all knowledge and/or skills items are covered in the final report and model submitted by each candidate. Centres should encourage group working, especially for those candidates from similar industrial backgrounds.

A system requirements template could be developed by the centre for varying manufacturing situations. The template should specify all available resources and their respective properties, ie inputs, outputs, downtime, manpower, product range, costs, quality levels. Candidates should be set simple tutorial tasks in order to build both competence and confidence before attempting the main core assessment task for both Outcomes 2 and 3. Part of these tutorial exercises should include some degree of analysis using 'what if' scenarios in order to assist the candidate to fully understand the benefits of simulated models.

The unit is designed to enable the candidate to gain skills in simulating and analysing a manufacturing system. These skills are by their nature generic and once acquired, can be applied to a range of modelling situations within the field of manufacturing.

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Guidance on the delivery and assessment of this unit

The delivery of this unit should be a mixture of didactic and candidate centred approaches.

Delivery and assessment time for Outcome 1 should be no more than 10 hours with the remainder of the notional unit delivery time being dedicated to Outcomes 2 and 3.

During the delivery of Outcome 1, candidates should be directed to appropriate text and video material available at the centre and on the Internet. This material, once sourced, should complement the delivery and assessment of Outcomes 2 and 3 for the model building and reporting requirements.

The unit can be approached from the standpoint of benchmarking an existing manufacturing process that is known to the candidate. The candidate should be encouraged to gather all relevant information pertinent to the creation of a simulated software model.

Candidates will require individual access to a personal computer, laptop or workstation preferably networked in order to provide effective back up of candidate files. It is anticipated that diskette storage will not provide effective back up alone.

Information on evidence requirements and assessment guidelines is given after Outcomes 1 and 3 in the SQA Advanced Unit Specification: statement of standards section. The written assessment should take place after Outcome 1 has been completed and the manufacturing systems model development and testing after the written test. Centres should develop checklists and marking schemes to support the assessment of Outcomes 2 and 3. Periodic reviews of candidate progress should take place in order to ensure that each candidate is making satisfactory progress towards meeting all the assessment requirements of the two outcomes. If a candidate's report fails to meet all requirements, then it should be re-submitted after a suitable period of remediation.

Opportunities for developing core skills

There may be opportunities to gather evidence towards the following listed core skills components in this unit, although there is no automatic certification of core skills or core skills components.

Reading Communication	SCQF level 6
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Open learning

In the event that this unit is delivered by open learning then the candidate will require to attend the centre for a minimum of one hour to undertake the written assessment for Outcome 1. For Outcomes 2 and 3 the candidate will need to provide a 'witness statement' from a responsible and competent person who can confirm that the evidence presented in the form of a report and software model is the candidate's own work. Periodic reviews, by centre staff, with the candidate should be carried out in order to complement and further validate the witness statement.

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.

General information for candidates

Unit title: Simulation of Advanced Manufacturing Systems

This unit has been designed to provide you with the knowledge and skills that will enable you to simulate an existing or proposed manufacturing system and, as a result of this modelling, improve the manufacturing system's operation. The centre where you study this unit is likely to introduce you to the latest manufacturing systems modelling software and analysis tools.

Before starting this unit you should have a basic knowledge and understanding of production planning and control methods used in industry together with knowledge of some manufacturing processes.

In Outcome 1 you will be introduced to the manufacturing process and all its related functions together with information processing requirements. Flexible manufacturing will be introduced along with associated material handling systems. It is likely that in order to enhance your learning of manufacturing systems modelling your lecturer will encourage you to access additional sources of information via supplier journals/magazines, videos and supplier sites on the Internet.

The assessment for Outcome 1 will consist of a written assessment paper which will last no more than one hour and will be conducted under closed-book conditions in which you will not be allowed to take notes, textbooks etc into the assessment.

The assessment for Outcomes 2 and 3 will be combined together and will involve you in creating and refining a simulated software model of a manufacturing system. Using the developed model, you will devise and run experiments in order to analyse possible changes that could impact on the normal operation of the manufacturing system. From these experiments, you will make recommendations for improvements to the manufacturing system based on your model's experimental results. You will be required to submit a written report plus your model in hardware and/or software format. During the assessment you should have access to a computer workstation and the Internet. You will also require to back up your work regularly preferably on a Compact Disc or other suitable storage medium.

By the end of the unit you should have developed your knowledge and skills in Simulation modelling in that you will be competent in benchmarking most manufacturing systems and are able to advise improvement based on efficient and effective use of available analysis tools and methods.