



Higher National Unit specification: general information

Unit title: Lean Manufacturing

Unit code: H0PP 34

Superclass: WA

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Unit purpose

This Unit has been designed to allow candidates' to develop their knowledge, understanding and skills in lean manufacturing concepts, tools and implementation. The Unit has been written in a generic format and may, therefore, be used in any HN award where Lean Manufacturing concepts and tools are considered relevant to the programme of study.

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

- 1 Explain lean manufacturing philosophy and associated concepts and practices.
- 2 Plan the transition of a manufacturing process to lean operations.

Recommended prior knowledge and skills

Entry is at the discretion of the centre however candidates should have good Communication and team working skills and knowledge of quality assurance and manufacturing processes. This may be evidenced by possession of the following: HN Units: *Communication: Practical Skills* (D77G 34), *Working with Others Core Skill* at SCQF level 5, *Quality Management: An Introduction* (DT8Y 34) and NQ Unit *Engineering Manufacturing Processes* at SCQF level 6 (F5KC 12).

Credit points and level

1 Higher National Unit credit at SCQF level 7: (8 SCQF credit points at SCQF level 7*)

**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 Access 1 to Doctorates.*

General information (cont)

Core Skills

There are opportunities to develop the Core Skills of Written Communication, Oral Communication, Critical Thinking, Planning and Organisation, Review and Evaluation and *Working with Others* at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

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.

Higher National Unit specification: statement of standards

Unit title: Lean Manufacturing

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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

Explain lean manufacturing philosophy and associated concepts and practices.

Knowledge and/or Skills

- ◆ Lean manufacturing philosophy
- ◆ Value
- ◆ Waste
- ◆ Value stream
- ◆ Pull versus push
- ◆ Lean leadership and management
- ◆ Visual management
- ◆ Workplace organisation (5S's)
- ◆ Key performance indicators
- ◆ Just In Time (JIT)
- ◆ Total Productive Maintenance (TPM)
- ◆ Continuous improvement

Evidence Requirements

Evidence for the Knowledge and/or Skills items in Outcome 1 should be provided on a sample basis. The evidence may be presented in response to specific questions. Each candidate will need to demonstrate that he/she can answer correctly questions based on a sample of the items shown under the Knowledge and/or Skills items in the Outcome. In any assessment of the Outcome eight out of twelve Knowledge and/or Skills items should be sampled.

Higher National Unit specification: statement of standards (cont)

Unit title: Lean Manufacturing

When 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:

- ◆ explain the philosophy behind lean manufacturing in terms of the elimination of waste or improving the flow or smoothness of work
- ◆ describe the concepts of value added and non-value added in lean methodology
- ◆ list four of the seven elements of waste and for each waste listed give a practical example
- ◆ explain what is meant by the term value stream in the context of lean manufacturing
- ◆ describe the difference between 'pull' and 'push' manufacturing processes in the context of lean manufacturing
- ◆ explain the types of leadership and management styles that are best suited to introducing lean methodologies
- ◆ explain the importance of visual management in lean manufacturing processes
- ◆ explain the importance of good workplace organisation in improving the efficiency of a manufacturing process
- ◆ define two of the following: Lead Time, Takt Time, Changeover Time, Overall Equipment Effectiveness or any other relevant KPI
- ◆ explain the role of a Just in Time (JIT) strategy in lean manufacturing
- ◆ list the five main elements of Total Productive Maintenance (TPM)
- ◆ explain how continuous improvement is a part of the development of a lean manufacturing process

Assessment should be conducted under controlled, supervised closed-book conditions in which candidates should not be allowed to take any handouts, notes or textbooks into the assessment.

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 2

Plan the transition of a manufacturing process to lean operations.

Knowledge and/or Skills

- ◆ Objectives
- ◆ Customer values
- ◆ Implementation team
- ◆ Team training requirements
- ◆ Lean tools
- ◆ KPI's
- ◆ Value stream maps
- ◆ Visual controls
- ◆ Outcomes from lean study

Higher National Unit specification: statement of standards (cont)

Unit title: Lean Manufacturing

Evidence Requirements

All Knowledge and/or Skills items in this assessment should be assessed.

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:

- ◆ Define clearly the objectives of the study
- ◆ Identify clearly the ultimate customer values (such as product quality and performance, delivery times and acceptable costs)
- ◆ Identify the membership of the lean team (this can be in terms of work titles rather than the name of individuals)
- ◆ Identify the training requirements of those involved in the lean team and explain how these requirements were met
- ◆ Explain the ways in which lean tools were used in the study and in any implementation of the system thereafter (eg Plan, Do, Check, Act (PDCA), Plan, Do, Study, Act (PDSA), Define, Measure, Analyse, Improve, Control (DMAIC))
- ◆ Identify the key KPIs used to measure improvements (eg Takt Time, Lead Time etc.)
- ◆ Prepare visual stream maps of the following:
 - Current state value stream
 - Future state(s) value Stream
- ◆ Identify any visual controls that will help in communicating manufacturing system information and control more easily
- ◆ Explain the Outcomes of the lean study justifying any potential changes to the manufacturing process

Assessment evidence should be generated by candidates undertaking a team based lean manufacturing study and producing individual reports covering the Knowledge and/or Skills items shown above. Candidates should produce their reports in their own time. Centres should make every reasonable effort to ensure that reports are candidates' own work. Where copying or plagiarism is suspected candidates may be interviewed to check their knowledge and understanding of the subject matter. A checklist should be used to record oral evidence of the candidate's knowledge and understanding.

While *Working with Others* is an important aspect of Lean Manufacturing, team working skills should not be formally assessed as part of the assessment of this Outcome.

Higher National Unit specification: support notes

Unit title: Lean Manufacturing

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 has been written in order to allow candidates to develop their knowledge, understanding and skills in the following areas;

- 1 Explaining lean manufacturing philosophy and associated concepts and practices.
- 2 Planning the transition of a manufacturing process to lean operations.

This Unit has been developed for the HNC and HND in Manufacturing Engineering awards but has been written in a generic format so that it can be used in any HN award where Lean Manufacturing concepts, thinking and skills are considered relevant to the programme of study. The Unit can also be offered on a free standing basis.

It is recommended that lecturers begin delivery of the Unit by setting the development of Lean Manufacturing in some form of historical context. Such a context, for example, may be the continuing desire to eliminate waste (or improve the efficiency) of manufacturing processes.

The historical context may include some or all of the following:

Adam Smith and the Wealth of Nations;
Benjamin Franklin in Poor Richard's Almanac and the Way to Wealth;
Frederick Taylor in the Principles of Scientific Management;
Henry Ford — mass production of the Model T car;
Taguchi and Deming;
Toyota Production System. (TPS).

In examining Ford's production methods candidates should be allowed to explore both the strengths and weaknesses of these methods in the context of the development of Lean Manufacturing. Candidates may also be encouraged to explore the differences between TPS, as operated by Toyota, and Lean.

While there may be different views on Lean Manufacturing philosophy it is possible to describe it in simple terms as a set of tools designed to identify and eliminate waste from a manufacturing process. As waste is reduced quality improves while production time and cost decrease. A second view of Lean, promoted by Toyota, relates to improving the 'flow' or 'smoothness' of a manufacturing process thus steadily reducing waste.

It is important that candidates understand the meaning of values in the context of Lean Manufacturing. In simple terms value added activity may be defined as that which the customer is prepared to pay for whereas non-added value activity is the waste that arises as a result of the present status of the manufacturing process.

Higher National Unit specification: support notes (cont)

Unit title: Lean Manufacturing

Candidates should be introduced to the following seven original wastes (muda) including their identification and elimination within manufacturing processes:

- Transport
- Inventory
- Motion
- Waiting
- Overproduction
- Over Processing
- Defects

The above seven waste can be remembered using the acronym 'TIM WOOD'. Lecturers may also wish to mention other wastes that have been identified such as the waste of untapped human potential, wasted energy and water, etc.

Candidates should be introduced to the concept of the value stream as, for example, the sequence of processes that deliver value to the customer. In this context flow may be seen as the movement of items between value added manufacturing processes without delay or interruption. The entire value stream flows through the complete supply chain from, at the beginning, raw materials to the finished product.

Candidates should be provided with plenty of opportunities to produce current and future value stream maps using recognised symbols as appropriate. Such maps may initially be drawn by hand using pencil but software may be used to draw maps as candidates confidence in value stream mapping improves.

Candidates may also be introduced to a range of quality improvement tools such as Plan, Do, Check, Act (PDCA), Plan, Do, Study, Act (PDSA), Define, Measure, Analyse, Improve, Control (DMAIC), Pareto Analysis, Cause and Effect Diagrams etc.

Lecturers should identify the major differences between push and pull manufacturing systems. In the former the manufacturer sets production levels in terms of historical ordering patterns from their customers. In contrast, in pull systems procurement, manufacturing and distribution of products is dictated by customer demand rather than any forecasting method.

Central to the success of lean manufacturing is the types of leadership and management styles an organisation adopts to implement lean. Candidates should be encouraged to identify the key management principles required for the successful implementation of Lean (eg Toyota's two pillars, relentless elimination of waste and respect for people).

Candidates should also examine the role that effective visual management can play in implementing a successful lean manufacturing process(es) (eg help understand and indicate work priorities, see whether performance is being met, show what standards of work should be, etc.)

Candidates should also consider the important role that workplace organisation can play in eliminating waste from a manufacturing process. The five Japanese S's (Sift, Sort, Sweep, Sustain and Self-discipline) should be used to illustrate the ways in which waste can be reduced by good workplace organisation.

Higher National Unit specification: support notes (cont)

Unit title: Lean Manufacturing

Candidates should be introduced to some of the typical Key Performance Indicators (KPI's) used in Lean Manufacturing such as Lead Time, Takt Time and Overall Equipment Effectiveness.

Candidates should explore what role Just in Time (JIT) supply plays in Lean Manufacturing. As part of this exploration lecturers may wish to explain the principles behind simple Kanban systems (eg two and three bin systems).

Candidates should be allowed to examine the important role that Total Productive Maintenance (TPM) plays in the long term success of a lean manufacturing process(es). TPM may be discussed in terms of five main elements: maintenance prevention, predictive maintenance, improvement maintenance, preventative maintenance and maintenance by operators of the equipment.

Candidates may also be introduced briefly to the Kaizen philosophy.

Guidance on the delivery of this Unit

Unit delivery should involve an appropriate blend of lecturing, group work, role play case studies and investigative work. Centres may use different forms of presentation material such as Power point presentations, videos and DVDs to illustrate different types of manufacturing systems and exemplify different areas of the Unit. Centres may choose to invite guest speakers to deliver some parts of the Unit's content.

Centres should encourage candidates to read extensively about Lean Manufacturing. There are a wide range of good materials available in textbooks, papers and on the Internet on Lean Manufacturing which candidates should be encouraged to read.

Structured industrial visits to companies that have introduced Lean Manufacturing processes are strongly recommended so that candidates can explore with company staff what improvements have been achieved, how lean was implemented and what issues arose in the process of introducing lean.

Candidates should be encouraged to work in groups during both the delivery and assessment of the Unit so that they can understand at first hand how team working may operate in practice. Such team working may help candidates to develop their Oral Communication and *Working with Others* Core Skills.

Lecturers should also challenge candidates' thinking on a range of Lean Manufacturing issues covered in the Unit, asking questions and suggesting alternative approaches where appropriate. This questioning approach should help to develop candidates' Critical Thinking skills. Candidates should have opportunities to develop their Planning and Organisation and Review and Evaluation Core Skills while undertaking the Lean Manufacturing study in Outcome 2. They should also be able to develop their written Communication Core Skills while preparing the Lean Manufacturing report for Outcome 2.

Higher National Unit specification: support notes (cont)

Unit title: Lean Manufacturing

Guidance on the assessment of this Unit

Outcome 1 may be assessed by a closed-book assessment paper sat at a single assessment event lasting one and a half hours. Outcome 2 may be assessed by candidates undertaking a team based lean manufacturing study and producing individual reports.

Assessment Guidelines

Outcome 1

Assessment may take the form of a single assessment paper lasting one and a half hours taken at a single assessment event. The assessment paper may comprise of an appropriate balance of short answer and restricted response questions.

Outcome 2

Centres may specify the product/manufacturing process that lean manufacturing concepts, thinking and tools should be applied to, or may leave it to the candidates to decide which product/manufacturing process they wish to analyse. Employed candidates may base their studies on a manufacturing process at their place of employment. Full-time education candidates may be provided with an appropriate case study which makes use of simulation software for assessment purposes.

Given that this is an introductory Unit to Lean Manufacturing, it is recommended that candidates base their studies on relatively simple manufacturing systems not involving major re-design of the system.

As candidates are likely to be new to Lean Manufacturing a lecturer may wish to act as a facilitator while the team engage in discussions on the planning for lean manufacturing operations. In the role of facilitator the lecturer should be well placed to focus the group's efforts, stimulate the team and ensure all members of the team are involved.

Centres may wish to specify the role of each candidate in the team (eg operator, team leader/supervisor, Purchase Department representative, etc.) or leave it to candidates to decide which roles they wish to assume.

Reports should normally be between 1,500 and 2,000 words in length plus diagrams and appendices. Centres may provide candidates with a format for their reports or leave it to the candidates to decide which format they wish to use.

Higher National Unit specification: support notes (cont)

Unit title: Lean Manufacturing

Online and Distance Learning

This Unit could be delivered by distance learning, which may incorporate some degree of on-line support. However, with regard to assessment, planning would be required by the centre concerned to ensure the sufficiency and authenticity of candidate evidence. Arrangements would be required to be put in place to ensure that the assessment paper for Outcome 1 is conducted under controlled, supervised conditions. Likewise centres are required to ensure that parts of the Lean Manufacturing study in Outcome 2 are undertaken as a team based exercise.

To keep administrative arrangements to a minimum, it is recommended that for distance learning candidates the assessment paper is taken at a single assessment event.

Opportunities for developing Core Skills

In summary, there are opportunities to develop the Core Skills of Written Communication, Oral Communication, Critical Thinking, Planning and Organisation, Review and Evaluation and *Working with Others* at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Information on Evidence Requirements and Assessment guidelines is given in Outcomes 1 and 2 of the Higher National Unit specification: statement of standards section. The assessment paper for Outcome 1 should be taken after the Outcome has been completed and the Lean Manufacturing study should take place during the delivery of Outcome 2.

Disabled candidates and/or those with additional support needs

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering whether any reasonable adjustments may be required. Further advice can be found on our website www.sqa.org.uk/assessmentarrangements

History of changes to Unit

Version	Description of change	Date

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General information for candidates

Unit title: Lean Manufacturing

Lean Manufacturing concepts, thinking and practices are increasingly being used in manufacturing processes in the United Kingdom. In simple terms lean manufacturing seeks to increase value for the customer by eliminating activities associated with a manufacturing process that do not contribute to this value. Such non-value activities are regarded as wasteful. During this Unit you will be introduced to lean philosophy and many of the concepts, tools and practices associated with lean manufacturing.

In order to study the Unit it would be helpful if you have developed good Communication and team working skills and knowledge of quality assurance and manufacturing processes. Successful achievement of the following Units give a good indication that you have the necessary knowledge and skills to take the Unit: HN Units: *Communication: Practical Skills, Working with Others* Core Skill at SCQF level 5, *Quality Management: An Introduction* and NQ Unit *Engineering Manufacturing Processes* at SCQF level 6.

It is likely that the Unit will be delivered by an appropriate balance of lectures, group work, role play, case studies and investigations. There is much information on Lean Manufacturing in textbooks, reports, papers and on the Internet and it is likely that your lecturer will encourage you to explore these sources of information during the delivery of the Unit.

While study the Unit you will also have opportunities to develop the Core Skills of Written Communication, Oral Communication, Critical Thinking, Planning and Organisation, Review and Evaluation and *Working with Others* at SCQF level 6 although there is no automatic certification of Core Skills or Core Skills components in the Unit.

Assessment for the Unit is likely to consist of a one and half hour assessment paper covering the content of Outcome 1 and a Lean Manufacturing study involving the planning required to implement lean operations to a manufacturing process. You will be expected to produce a report of between 1,500 and 2,000 words plus diagrams to cover the Knowledge and/or Skills items for Outcome 2.