

Cambridge **TECHNICALS LEVEL 3**

Cambridge
TECHNICALS
2016

ENGINEERING

Unit 18

Lean and quality

R/506/7284

Guided learning hours: 60

VERSION 4 - June 2017 black line indicates updated content

LEVEL 3

UNIT 18: LEAN AND QUALITY

R/506/7284

Guided learning hours: 60

Essential resources required for this unit: none

This unit is internally assessed and externally moderated by OCR.

UNIT AIM

Striking an effective balance between efficiency of production and quality of product without compromising either is fundamental to the commercial success of engineering companies.

The aim of this unit is for learners to develop their understanding of the principles behind lean manufacturing and apply their understanding to a manufacturing context in terms of improving quality, eliminating waste and improving productivity.

They will also learn about a wide range of quality control, assurance and management techniques including mathematical analysis of quality data to identify trends and recommend subsequent improvements to processes or procedures.

Learners will apply the knowledge and understanding gained to the development production plans, factory layouts and manufacturing processes.

TEACHING CONTENT

The teaching content in every unit states what has to be taught to ensure that learners are able to access the highest grades.

Anything which follows an i.e. details what must be taught as part of that area of content. Anything which follows an e.g. is illustrative, it should be noted that where e.g. is used, learners must know and be able to apply relevant examples in their work, although these do not need to be the same ones specified in the unit content.

For internally assessed units you need to ensure that any assignments you create, or any modifications you make to an assignment, do not expect the learner to do more than they have been taught, but must enable them to access the full range of grades as described in the grading criteria.

Please note – if learners are completing this unit as part of the Extended Diploma qualification they will be required to complete the synoptic unit 25: Promoting continuous improvement. Before your learners complete the assessment of this unit, you must refer to the specification and model assignment requirements for unit 25, so if applicable you can ensure learners gather the appropriate feedback on their own performance and performance of the system, process or artefact that they may have produced in this unit.

Learning outcomes	Teaching content
The Learner will:	Learners must be taught:
<p>1. Understand lean manufacturing</p>	<p>1.1 lean principles, i.e.</p> <ul style="list-style-type: none"> • specify 'value' in the eyes of the end user • map the value stream • make the product flow • let the customer pull the product • strive for perfection <p>1.2 lean wastes, i.e. TIMWOOD(S)</p> <ul style="list-style-type: none"> • Transport • Inventory • Movement • Waiting • Overproduction <ul style="list-style-type: none"> ○ Overprocessing ○ Defects • (8th waste) – Skills • Muda, Muri, Mura • lean tools and techniques (e.g. 5S, Kaizen, Kanban, heijunka, value stream mapping, takt time i.e. available working time ÷ customer demand, one piece flow, right first time) • just in time (JIT) (e.g. advantages, risks, costs) • production planning and factory layout, i.e. <ul style="list-style-type: none"> ○ scales of production (e.g. one off, batch, continuous) ○ cellular and linear ○ mapped to value stream ○ make to order (MTO) or make to replenish (MTR) <p>1.3 lean tools and techniques, e.g.</p> <ul style="list-style-type: none"> • 5S • Kaizen • Kanban • heijunka • value stream mapping • takt time i.e. available working time ÷ customer demand • one piece flow • right first time • just in time (JIT) • advantages • risks • costs • production planning and factory layout, i.e. <ul style="list-style-type: none"> ○ scales of production (e.g. one off, batch, continuous) ○ cellular and linear ○ mapped to value stream ○ make to order (MTO) or make to replenish (MTR)

Learning Outcomes	Teaching Content
The Learner will:	Learners must be taught:
<p>2. Understand approaches used to ensure quality in manufacturing</p>	<p>2.1 quality control 2.2 quality assurance 2.3 total quality management (TQM) i.e.</p> <ul style="list-style-type: none"> • production responsibility <ul style="list-style-type: none"> ○ jidoka • perfection • line stop • process control • standardisation • project by project improvement <p>2.4 statistical process control i.e.</p> <ul style="list-style-type: none"> • measurement of data • upper and lower control limits • tolerances • trends and data • mathematical calculation (e.g. statistics and probability – data sets, mean, mode and median, sampling, standard deviation, solution using distribution) • lean in quality, i.e. <ul style="list-style-type: none"> ○ 6 Sigma ○ DMAIC
<p>3. Be able to apply lean manufacturing and approaches used to ensure quality</p>	<p>3.1 identification of lean wastes in manufacturing situations 3.2 suggested improvements to a manufacturing process i.e.</p> <ul style="list-style-type: none"> • implementation of lean tools (reducing movement or waiting times, balancing of production levels) • quality improvement strategies (e.g. use of statistical process control (SPC), 5S) <p>3.3 industrial best practice 3.4 measuring performance improvements i.e.</p> <ul style="list-style-type: none"> • interpretation of SPC data • improvements in cycle time • reduction in takt time • removal of defects • productivity improvement e.g. (individual cell, machine or staff performance, production levels per working shift, meeting customer demand)

Learning outcomes	Teaching content
The Learner will:	Learners must be taught:
<p>4. Be able to plan manufacturing production using lean and quality principles and approaches</p>	<p>4.1 production planning i.e.</p> <ul style="list-style-type: none"> • operations and processes • time • materials • tools • machinery <p>4.2 influencing factors i.e.</p> <ul style="list-style-type: none"> • scales of production • machine capacity • operation or process limitations <p>4.3 planning to include lean and quality i.e.</p> <ul style="list-style-type: none"> • impact of production limitations e.g. (batch production, tool change over) <p>4.4 manipulation of takt time and cycle time</p> <p>4.5 use of JIT and Kanban</p> <p>4.6 implementation of quality and inspection techniques</p> <p>4.7 automated and manual processes (e.g. assembly processes, Poke Yoke, Andon)</p> <p>4.8 factory or production layout i.e.</p> <ul style="list-style-type: none"> • inventory management (e.g. position of kanban and supermarkets, work in progress (WIP)) <p>4.9 minimising the lean wastes</p> <p>4.10 cellular and linear production</p> <p>4.11 made to order (MTO) or made to replenish (MTR) variations in layout</p>

GRADING CRITERIA

LO	Pass	Merit	Distinction
	The assessment criteria are the Pass requirements for this unit.	To achieve a Merit the evidence must show that, in addition to the Pass criteria, the candidate is able to:	To achieve a Distinction the evidence must show that, in addition to the pass and merit criteria, the candidate is able to:
1. Understand lean manufacturing	P1 Explain the principles of lean manufacturing.	M1 Analyse how lean tools and techniques can be used to improve productivity and business performance in manufacturing.	
	P2 Explain how lean wastes may occur in a manufacturing environment.		
2. Understand approaches used to ensure quality in manufacturing	P3 Explain a range of approaches used to ensure quality in manufacturing.	M2 Evaluate how quality issues can impact on productivity and business performance in manufacturing.	
	P4 Interpret the results of quality control data through the use of statistical mathematical calculation. <i>*Synoptic assessment – Unit 1 Mathematics for engineering</i>		
3. Be able to apply lean manufacturing and approaches used to ensure quality	P5 Identify lean waste in manufacturing situations.	M3 Recommend solutions to identified lean waste and quality issues.	D1 Evaluate the impact of recommended solutions with reference to industrial best practice and measurement of performance improvement.
	P6 Explain potential quality issues in a manufacturing process.		

LO	Pass	Merit	Distinction
4. Be able to plan manufacturing production using lean and quality principles and approaches	P7 Assess existing process and manufacturing layouts for the production of a component or product.	M4 Design a process and manufacturing layout for the production of a component or product effectively using lean and quality principles and approaches.	D2 Justify how the process and manufacturing layout adheres to lean and quality principles and approaches.
	P8 Create a production plan for a manufactured component or product which includes consideration of lean and quality principles and approaches, and influencing factors.		

*SYNOPTIC ASSESSMENT AND LINKS BETWEEN UNITS

When learners are taking an assessment task, or series of tasks, for this unit they will have opportunities to draw on relevant, appropriate knowledge, understanding and skills that they will have developed through other units. We've identified those opportunities in the grading criteria. Learners should be encouraged to consider for themselves which skills/knowledge/understanding are most relevant to apply where we have placed an asterisk.

ASSESSMENT GUIDANCE

LO1: Understand lean manufacturing

Learners should explain the principles of lean manufacturing, and analyse the application of lean tools and techniques. Teachers might use suitable case studies on which learners could base their explanation and analysis.

LO2: Understand approaches used to ensure quality in manufacturing

Learners should explain approaches to learning and analyse the impact of quality on productivity and business performance. P4 provides learners with the opportunity to draw on knowledge learnt in Unit 1 with the application of statistical techniques. Teachers could use suitable case study activities which enable learners to explore quality.

LO3: Be able to apply lean manufacturing and approaches used to ensure quality

Learners should be able to apply lean manufacturing approaches and techniques. Teachers could use suitable case study activities which enable learners to identify and apply lean manufacturing approaches.

LO4: Be able to plan manufacturing production using lean and quality principles and approaches

Learners should be able to plan manufacturing production using lean and quality principles and techniques. Teachers might use suitable case study examples that enable learners to create plans, design process and manufacturing layouts and provide justifications.

Feedback to learners: you can discuss work-in-progress towards summative assessment with learners to make sure it's being done in a planned and timely manner. It also provides an opportunity for you to check the authenticity of the work. You must intervene if you feel there's a health and safety risk.

Learners should use their own words when producing evidence of their knowledge and understanding. When learners use their own words it reduces the possibility of learners' work being identified as plagiarised. If a learner does use someone else's words and ideas in their work, they must acknowledge it, and this is done through referencing. Just quoting and referencing someone else's work will not show that the learner knows or understands it. It has to be clear in the work how the learner is using the material they have referenced to inform their thoughts, ideas or conclusions.

For more information about internal assessment, including feedback, authentication and plagiarism, see the centre handbook. Information about how to reference is in the OCR Guide to Referencing available on our website: <http://www.ocr.org.uk/i-want-to/skills-guides/>.

MEANINGFUL EMPLOYER INVOLVEMENT - a requirement for the Foundation Diploma, Diploma and Extended Diploma (tech level) qualifications

The 'Diploma' qualifications have been designed to be recognised as Tech Levels in performance tables in England. It is a requirement of these qualifications for centres to secure for every learner employer involvement through delivery and/or assessment of these qualifications.

The minimum amount of employer involvement must relate to at least one or more of the elements of the mandatory content (this unit is a mandatory unit in the Manufacturing pathway).

Eligible activities and suggestions/ideas that may help you in securing meaningful employer involvement for this unit are given in the table below.

Please refer to the *Qualification Handbook* for further information including a list of activities that are not considered to meet this requirement.

Meaningful employer engagement	Suggestion/ideas for centres when delivering this unit
1. Learners undertake structured work-experience or work-placements that develop skills and knowledge relevant to the qualification.	<ul style="list-style-type: none">• Students undertake work placements in businesses where lean manufacturing and quality principles are applied. Students should be able to see, first hand, the application of the tools, techniques and methodologies that contribute to improved productivity within the business.
2. Learners undertake project(s), exercises(s) and/or assessments/examination(s) set with input from industry practitioner(s).	<ul style="list-style-type: none">• Industrial practitioners launch learning activities that are current live projects.• Employers host development days where they actively participate in unit delivery, ensuring industrial delivery of skills.• Engineering employers set productivity improvement challenges where students have to take an existing process and apply lean and quality tools and techniques to improve its performance.

Meaningful employer engagement	Suggestion/ideas for centres when delivering this unit
<p>3. Learners take one or more units delivered or co-delivered by an industry practitioner(s). This could take the form of master classes or guest lectures.</p>	<ul style="list-style-type: none"> • Ensure employer input through master classes where employers showcase best practice methodologies in the use of lean and quality tools and methodologies. • Employers deliver lectures, talks or seminars that explain how they utilise lean and quality tools and methodologies within their business. • Employers deliver sessions that showcase the link across skills and units. This may include the link between lean and quality and business for engineering or lean and quality and statistical analysis techniques explored in mathematics.
<p>4. Industry practitioners operating as 'expert witnesses' that contribute to the assessment of a learner's work or practice, operating within a specified assessment framework. This may be a specific project(s), exercise(s) or examination(s), or all assessments for a qualification.</p>	<ul style="list-style-type: none"> • Employers are involved in the setting of assessment material and then subsequently act to verify the standard of the students work against industrial practice. • Employers set industrial level tasks that students have to solve. This may be a business improvement challenge, a quality exercise or a full business simulation scenario, possibly set across this unit and Business for Engineering.

To find out more

ocr.org.uk/engineering

or call our Customer Contact Centre on **02476 851509**

Alternatively, you can email us on **vocational.qualifications@ocr.org.uk**



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