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OCR
Oxford Cambridge and RSA

Cambridge **TECHNICALS LEVEL 3**

Cambridge TECHNICALS 2016

ENGINEERING

Unit 25

Promoting continuous improvement

A/615/1559

Guided learning hours: 30

Version1

ocr.org.uk/engineering

LEVEL 3

UNIT 25: PROMOTING CONTINUOUS IMPROVEMENT A/615/1559

Guided learning hours: 30

This unit is to be assessed at the end of the learning programme. While carrying out tasks for the summative assessment activity learners will draw on their skills, knowledge and understanding acquired through other units.

Unit aim

The best engineers follow the principle that they must be committed to maintaining high standards of work in every aspect. This means that engineers should continually be looking to improve the standards and quality of their work.

It is very unusual to see a successful engineer using just one or two of the techniques they have developed. Rather it is the combination and appropriate use of skills, knowledge and techniques from a range of areas that distinguishes the successful engineer. These should be used alongside the principles of continuous improvement and total quality management (TQM)

In this unit you will learn how to take the different skills and tools developed in the course to date and use them to raise the standards and quality of your work.

You will use a system, process or artefact you have engineered during a practical activity from units that you have already completed, you will use what you have learned in the qualification to modify it in some way. By modify this means that you might look to make aesthetic improvements, use improved production method, use alternative materials or carry out production for a revised purpose.

This unit will help you to develop the skills required to recognise and combine your engineering learning to achieve a better outcome.

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.

Learning Outcome The Learner will:		**Teaching Content The Learner must be taught:**
1. Be able to reflect on own performance and performance of systems, processes or artefacts	1.1	Methods of assessing own performance and systems, processes or artefacts i.e. • feedback i.e. o verbal (e.g. interviews, focus group) o written (e.g. surveys, questionnaires) o formal reviews (e.g. 360° feedback, performance review, stop-start-continue, panel review) o informal reviews (e.g. non-structured, limited documentation) • sources (e.g. peers, colleagues, line managers, stakeholders)
	1.2	Review own performance i.e. • strengths and areas for improvement • skills that have been applied to processes and outcomes i.e. o personal skills (e.g. communication, team work, following instructions) o practical skills (e.g. designing, CAD/CAM, use of tools and machinery, programming, making) • how own performance contributed to achievement of processes and outcomes • areas for own improvement
	1.3	Review performance of a system, process or artefact i.e. • measures/ success criteria (e.g. within scope, met agreed outcomes or objectives, feasible, accurate, complete) • results and recommendations • lessons learned

Learning Outcome The Learner will:		Teaching Content The Learner must be taught:
2. Be able to develop a plan for improvements to a system, process or artefact	2.1	Purpose of improvement plans (e.g. the benefits and reasons for use)
	2.2	Key areas of an improvement plan i.e. • evidence (e.g. from appraisal/ feedback) • analysis (e.g. against key performance indicators, identify patterns and trends in feedback data (e.g. histograms, frequency polygons, cumulative frequency curves) • conclusions/ recommendations (e.g. identifications of modifications/ changes, desired outcomes) • Plan (e.g. how modifications/changes will be achieved, skills needed, time frames, equipment needed)
	2.3	Considerations when developing an improvement plan, i.e. • performance indicators for the system, process or artefact to be measured (e.g. accuracy of measurement, time to complete, fit for purpose, meets specification, cost) • identification of desired outcomes (e.g. aesthetic improvements, improved production method, use of alternative materials, production for a revised purpose) • actions needed to address performance discrepancies and identification of necessary skills, knowledge and understanding to achieve desired outcomes (e.g. practical and personal skills)
	2.4	Create a plan for improvements to a system, process or artefact
3. Be able to implement a plan to make improvements	3.1	How to follow a plan to make improvements to the system, process or artefact i.e. • ensuring improvement plan runs to time • escalating deviations from the plan (e.g. unplanned events, interruptions, bottlenecks) • implementing contingency actions

GRADING CRITERIA

Learning Outcome	Pass	Merit	Distinction
The learner will:	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. Be able to reflect on own performance and performance of systems, processes or artefacts	***P1:** Describe own performance when engineering a system, process or artefact and reflect on: • own strengths and areas for improvement • personal skills • practical skills • achievement of processes and outcomes 1.1, 1.2	***M1:** Evaluate own performance and make recommendations for improvements to own performance when engineering a system, process or artefact	***D1:** Justify the decisions made, including reasons why any options were rejected when making recommendations for improvements to your system, process or artefact in your improvement plan
	***P2:** Analyse performance of a system, process or artefact you have engineered with reference to: • measures/ success criteria • results and recommendations • lessons learned 1.1, 1.3	***M2:** Recommend improvements to your system, process or artefact	
2. Be able to develop a plan for improvements to a system, process or artefact	***P3**: Create a plan for improvements to a system, process or artefact you have engineered, with reference to: • Performance indicators • Desired outcomes • Required actions • Skills needed to achieve outcomes 2.1, 2.2, 2.3, 2.4		
3. Be able to implement a plan to make improvements	***P4:** Follow your plan to make improvements to a system, process or artefact you have engineered 3.1	***M3**: Evaluate the effectiveness of your plan against the desired outcomes to the system, process or artefact	

ASSESSMENT GUIDANCE

This synoptic unit is an opportunity for the learners to reflect on and use skills and knowledge they have developed during the qualification. This unit should be the last unit assessed in the qualification, though tutors may decide to deliver the learning holistically throughout the qualification. Learners should focus on learning gained prior to the delivery of this unit rather than the learning being delivered again in this unit.

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/.

LO1 Be able to reflect on own performance and performance of systems, processes or artefacts

For P1, learners need to reflect on their own performance, describing strengths and areas for improvement. For P2, learners need to analyse the performance of a system, process or artefact that they have engineered. P1 and P2 should inform their review of a process or outcome that learners have completed and have chosen to improve.

For M1 and M2 learners should use knowledge, skills and understanding from any area of the qualification that are relevant to the process or outcome they have chosen to improve. For M1 learners should be able to clearly demonstrate how they have arrived at their recommendations for improvements to their own performance when engineering a system, process or artefact. For M2 learners should be able to clearly demonstrate how they have arrived at their recommendation for improvements to the system, process or artefact.

For D1 any recommendations must be justified by clear links to any evidence.

LO2 Be able to develop a plan for improvements to a system, process or artefact

For P3, it should be noted that that the improvement that learners undertake does not have to be a whole process/ artefact. It could be a sub-process or part of an artefact. Learners must draw on the skills, knowledge and understanding gained from previous units to plan the improvement that they will perform.

LO3 Be able to implement a plan to make improvements

For P4 learners must follow the improvement plan created in P5. Learners must draw on the skills, knowledge and understanding gained from previous units to follow the plan and make the necessary improvements.

For M2 learners should evaluate the achievement of any desired outcomes to the system, process or artefact that they had planned for.

LINKS BETWEEN UNITS AND SYNOPTIC ASSESSMENT

This synoptic unit draws on skills and knowledge gained throughout the qualification. Depending on the context for the task set, it is possible for a learner to make a suitable link with any learning outcome from the previously studied units. This table shows some of the links that are likely to be common. It should be noted that this assessment covers both the Mechanical, Electrical and Electronic Systems Design and Engineering and Engineering Automation Control and Manufacturing Processes Pathways. The assessment links listed in the table below will vary depending on the pathway that learners have followed, however, where do they do apply to a pathway, it is crucial that learners apply the skills, knowledge and understanding from these units to the assessment of unit 25.

Name of other unit	Related LO	Relevant synoptic assessment opportunities in Unit 25
Unit 5	LO1 Be able to apply AC and DC circuit theory to circuit design LO4 Be able to use semi-conductors in electrical and electronic design LO5 Understand the application of programmable process devices in electronic design	If learners decide to make their improvement to any system, process or artefact that requires electrical and electronic design then learners must use knowledge of AC and DC circuit theory, which will include semiconductors and programmable devices. Learners will also have studied Unit 4, as it is mandatory to both pathways. Unit 4 will provide knowledge, skills and understanding of circuit theory, which learners must also apply to their improvement if appropriate.
Unit 6	LO1 Be able to use Computer Aided Design (CAD) for circuit design and simulation LO3 Be able to manufacture and construct electronic circuits safely LO4 Be able to test and perform fault-finding on electronic circuits	If learners decide to make their improvement to any system, process or artefact that requires circuit or PCB design and manufacture then learners must use knowledge of CAD. They must also apply knowledge of accurate fault finding processes and procedures, in order to identify any improvements needed. Learners must follow safety procedures for manufacturing and constructing electronic circuits and use quality assurance techniques in any improvements that they make.
Unit 8	LO2 Be able to work safely with electricity LO3 Be able to construct electrical and electronic circuits LO4 Be able to fault find in electrical and electronic equipment	If learners decide to make their improvement to any system, process or artefact that requires electrical operations then learners must use knowledge of working safely with electricity, and knowledge, skills and understanding of the construction of electrical and electronic circuits. LO4 will be necessary for learners to identify the need for any improvements and to test any improvements that are eventually made. Learners will also have studied Unit 4, as it is mandatory to both pathways. Unit 4 will provide knowledge, skills and understanding of circuit theory, which learners must also apply to their improvement if appropriate.

Name of other unit	Related LO	Relevant synoptic assessment opportunities in Unit 25
Unit 9	LO1 Be able to use graphical and engineering drawing techniques to communicate design solutions LO2 Be able to select appropriate engineering materials to achieve design solutions LO3 Be able to design components that can be successfully manufactured LO4 Be able to optimise design to improve performance	If learners decide to make their improvement to any system, process or artefact that requires mechanical design then learners must use knowledge of graphical and engineering drawing techniques, and knowledge, skills and understanding of appropriate engineering materials in order to design components for manufacturing and to achieve their improvement. LO4 will be necessary for learners to identify the need for any improvements; learners will be able to identify ways to optimise their design to improve it. Learners will also have studied Unit 2, as it is mandatory to both pathways. Unit 2 will provide knowledge, skills and understanding of materials science which learners must also apply where the improvement features the use of alternative materials.
Unit 10	LO1 Be able to produce 3D models using Computer Aided Design (CAD) LO2 Be able to create 3D assemblies of components within a CAD system LO3 Be able to produce 2D CAD engineering drawings LO4 Understand the use of simulation tools within CAD systems	If learners decide to make their improvement to any system, process or artefact that requires computer aided design then learners must use knowledge of 3D models and simulations using CAD. Learners will also have studied Unit 2, as it is mandatory to both pathways. Unit 2 will provide knowledge, skills and understanding of materials science which learners will need to utilise when completing CAD models and simulations in order to achieve their improvement.
Unit 12	LO1 Be able to carry out simulations to establish reactions in moving mechanical assemblies LO2 Be able to carry out simulations to assess the manufacturability of components or products LO3 Be able to carry out Finite Element Analysis (FEA) simulations to assess the operational performance of components LO4 Be able to carry out Computational Fluid Dynamic (CFD) simulations to assess the operational performance of components	If learners decide to make their improvement to any system, process or artefact that requires mechanical simulation and modelling then learners must use knowledge of simulations to assess the manufacturability and operational performance of components, including finite element analysis. Learners must also use computational fluid dynamic simulations to assess the operational performance of components. All of this will enable learners to identify the need for improvement and inform the nature of it.

Name of other unit	Related LO	Relevant synoptic assessment opportunities in Unit 25
Unit 13	LO1 Be able to plan for production in mechanical engineering LO2 Be able to use bench processes, tools and equipment to produce quality components LO3 Be able to use the centre lathe to produce quality components LO4 Be able to use drilling and milling machines to produce quality components LO5 Be able to quality assure components	If learners decide to make their improvement to any system, process or artefact that requires mechanical operations then learners must use bench processes and tools and manufacturing equipment (lathes, milling machines and drills) to carry out their improvement. LO1 will enable learners to construct the production plan as part of their improvement plan, showing where processes are timed and discrepancies are identified. LO5 will enable learners to quality assure their artefacts and identify necessary improvements. It will also enable them to subsequently quality assure the improvement that they complete.
Unit 14	LO2 Understand the implementation of control in automated systems LO3 Understand sensors and actuators used in automation control systems LO4 Know about industrial network systems LO5 Know about maintenance in automation control systems LO6 Understand the application of robotics in automation control systems	If learners decide to make their improvement to any system, process or artefact that requires automation, control and robotics then learners must use knowledge and understanding of automated control systems and their components, industrial network systems and automated processes such as robotics. Learners will also have studied Unit 4, as it is mandatory to both pathways. Unit 4 will provide knowledge, skills and understanding of circuit theory, which learners must also apply to their improvement if appropriate.
Unit 15	LO2 Understand the electrical elements of control systems LO3 Understand simple hydraulic systems LO4 Understand simple pneumatic systems	If learners decide to make their improvement to any system, process or artefact that requires electrical, mechanical, hydraulic and pneumatic control then learners must use knowledge and understanding of electro-mechanical, hydraulic and pneumatic systems. Learners will also have studied Unit 3, as it is mandatory to both pathways. Unit 3 will provide knowledge, skills and understanding of dynamic systems, which learners must also apply to their improvement if appropriate. Learners will also have studied Unit 4, as it is mandatory to both pathways. Unit 4 will provide knowledge, skills and understanding of circuit theory, which learners must also apply to their improvement if appropriate.

Name of other unit	Related LO	Relevant synoptic assessment opportunities in Unit 25
Unit 16	LO2 Be able to program embedded devices in a system LO3 Be able to program Programmable Logic Controllers (PLCs) LO4 Understand commercial testing and validation strategies	If learners decide to make their improvement to any system, process or artefact that requires systems and programming then learners must use Programmable Logic Controllers (PLCs) (including the principles of ladder logic programming), and other embedded devices for a control system LO4 will enable learners to identify necessary improvements. Learners will also have studied Unit 4, as it is mandatory to both pathways. Unit 4 will provide knowledge, skills and understanding of circuit theory, which learners must also apply to their improvement if appropriate.
Unit 17	LO1 Understand how computers are used in manufacturing systems LO2 Be able to produce CNC programs for the manufacture of components LO3 Be able to set-up and operate a CNC machine to produce components LO4 Be able to produce components using additive manufacturing techniques	If learners decide to make their improvement to any system, process or artefact that requires computer aided manufacture then learners must use knowledge of how CAM systems are used within manufacturing and be able to program and use Computer Numerical Control (CNC) machines to produce components. LO2 will enable learners to construct the CNC programme as part of their improvement plan and calculate cutter speed and feed rates. LO4 will enable learners to produce components required for the improvement.
Unit 19	LO3 Understand how destructive testing methods are used for quality assurance in manufacturing LO4 Understand how non-destructive testing methods are used for quality assurance in a manufacturing environment LO5 Understand automatic inspection and testing techniques which are used in manufacturing	If learners decide to make their improvement to any system, process or artefact that requires inspection and testing then learners must use knowledge of different methods of inspection and testing (including both destructive and non-destructive testing) and how the use of these methods contributes to quality control, and how defects can form in manufacturing components, processes and materials. Learners will also have studied Unit 2, as it is mandatory to both pathways. Unit 2 will provide knowledge, skills and understanding of materials science and properties of materials which learners must also apply where the improvement features the use of alternative materials.

Name of other unit	Related LO	Relevant synoptic assessment opportunities in Unit 25
Unit 21	LO3 Be able to analyse reliability-centred maintenance data LO4 Be able to plan maintenance operations LO5 Be able to undertake maintenance operations LO6 Understand how maintenance issues can inform design	If learners decide to make their improvement to any system, process or artefact that requires maintenance then learners must use knowledge of different maintenance strategies and operations, then to be able to plan and undertake maintenance operations themselves. Learners must analyse maintenance data and use knowledge of failure modes, and how maintenance issues can inform future design. This will enable learners to identify necessary improvements. Learners will also have studied Unit 1, as it is mandatory to both pathways. Unit 1 will provide knowledge, skills and understanding of maintenance schedules and statistical analysis of maintenance plans, to include: Mean time between failures (MTBF) Mean time to repair (MTTR) Mean time to failure (MTTF) Standard deviation and extreme performance variations Learners can use this knowledge to identify necessary improvements and calculate how to adjust a maintenance schedule appropriately. Learners will also have studied Unit 2, as it is mandatory to both pathways. Unit 2 will provide knowledge, skills and understanding of materials science and properties of materials which learners must also apply where the improvement features the use of alternative materials.

MEANINGFUL EMPLOYER ENGAGEMENT

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

The minimum amount of employer involvement must relate to at least one or more of the elements of the mandatory content.

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. Students undertake structured work-experience or work-placements that develop skills and knowledge relevant to the qualification.	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 or quality within the business.

2. Students undertake project(s), exercises(s) and/or assessments/examination(s) set with input from industry practitioner(s).	Measure and inspection of components using industry standard equipment, to determine if the product and production method is capable. (PPAP and SPC run charts)
3. Students 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.	Input from practicing engineers involved in product inspection, development and testing. Input to include examples of methodology, calculations and working documentation within professional commercial engineering practice.
4. Industry practitioners operating as 'expert witnesses' that contribute to the assessment of a student'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.	Input from practicing engineers relating to the clarity of diagrams and correct identification of inspection and or testing principles in operation during project work and documentation

RESOURCES

Skills for self-reflection. Online advice from the Open University
http://www.open.ac.uk/choose/unison/develop/my-skills/self-reflection

Skills for reflective practice: http://www.skillsyouneed.com/ps/reflective-practice.html

Creating an action plan: Youtube Video https://www.youtube.com/watch?v=K1EHZW4oFGg

Giving and receiving feedback: https://open.buffer.com/how-to-give-receive-feedback-work/

Getting honest feedback: https://www.entrepreneur.com/article/246556

360°feedback process: http://smallbusiness.chron.com/360-degree-performance-appraisal-process-1923.html

Pros and cons of 360°feedback:
https://www.shrm.org/hrdisciplines/employeerelations/articles/pages/360degreeperformance.aspx

Tips for effective performance review:
http://www.businessmanagementdaily.com/glp/25459/Performance-Review-Examples.html

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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