Unit 3: Engineering Project

Unit code: T/600/0252

QCF Level 3: BTEC National

Credit value: 20

Guided learning hours: 120

● Aim and purpose

This unit aims to enable learners to specify, plan and implement an engineering project and present its outcome.

● Unit introduction

In the modern world engineers and technicians are often involved fully or in part with identifying problems and finding suitable solutions. These engineering problems may range from a very large project, such as designing and building a hydroelectric power station, to smaller projects, such as designing and producing a paper clip to keep notes secure. No matter how large or small, these problems need to be project managed in order to find engineered solutions. This unit will provide learners with opportunities to present their own solutions to engineering projects and should enable them to feel confident in carrying out project work within their chosen engineering discipline at the technician level.

The unit aims to integrate the knowledge and skills learners have gained throughout their programme of study, into a major piece of work that reflects the type of performance expected of an engineering technician. The project is intended to develop the learner's ability to identify and plan a course of action and follow this through to produce a viable solution/outcome to an agreed specification and timescale.

The end result of the project could be an engineering product, device, service or process or a modification to an existing process or product. As in the real world, the outcome of the project and its presentation are very important, although this project is also about developing the process skills necessary to carry out the project. Throughout the project learners will need to apply the technical skills developed in the other units in the qualification.

● Learning outcomes

On completion of this unit a learner should:

1   Be able to specify a project, agree procedures and choose a solution

2   Be able to plan and monitor a project

3   Be able to implement the project plan within agreed procedures

4   Be able to present the project outcome.

Unit content

1 Be able to keep records, specify a project, agree procedures and choose a solution

Project records: written eg notes, sketches, drawings; plans and modified plans; targets (setting, monitoring); use of planning tools eg paper based, electronic; recording initial concepts eg lists, notes, mind mapping, flow diagrams, sketches

Initial concepts: setting limits eg time, cost, feasibility, need; value–cost–benefit analysis; generating ideas eg group discussion, brainstorming, mind mapping; research techniques; lines of communication

Specification: type of project eg product design, plant layout/maintenance, production methods or similar engineering-related topics; technical information eg functionality, reliability, operational conditions, process capability, scale of operation, size, capacity, cost, style, ergonomics, present and future trends; health and safety issues; environmental and sustainability issues; quality standards and legislation; timescales; physical and human resource implications

Procedures: roles and responsibilities eg decision making, budget planning and control; reporting methods; resource allocation and limits

Techniques: comparison methods eg statistical, graphical, quality and resource requirements/limitations, process capability, fitness-for-purpose; analysis eg cost–benefit, feasibility

2 Be able to plan and monitor a project

Planning: long-term planning eg planners, charts and scheduling techniques (flow charts, Gantt charts, critical path methods, software packages); setting priorities; useful resource information eg human and physical

Monitoring: monitor and record achievement eg use of logbook and/or diary for record keeping (names, addresses, telephone numbers, meeting dates, email and other correspondence lists); use of logbook eg for recording and analysing data or performance records, modifying/updating charts/planners, recording project goals and milestones, initial concepts, project solution technical decisions and information

3 Be able to implement the project plan within agreed procedures

Implement: proper use of resources eg equipment, tools, materials, within agreed timescale, use of appropriate techniques for generating solutions, adapting project plan where appropriate, maintaining appropriate records

Checking solutions: use of evaluative and analytical techniques eg graphs, matrix methods, statistics, Gantt charts, sequencing, scheduling, critical path methods, computer software packages

4 Be able to present the project outcome

Presentation: deliver a presentation to a small group eg audience including known (peer group, tutors) and unknown (actual or simulated customer or client) participants; use of preparation techniques, presentation styles and techniques; preparation and use of visual aids eg overhead transparencies, software packages and projectors, charts, models, video/DVD clips

Project report: logbook/diary record of all events; written technical report including relevant drawings/ circuit diagrams, sketches, charts, graphs etc appropriate to the project solution; use of information and communication technology (ICT) as appropriate to present findings eg CAD, DTP, spreadsheets, databases, word processing

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
P1 prepare and maintain project records from initial concepts through to solution that take account of and record changing situations	**M1** maintain detailed, concurrent records throughout the project that clearly show progress made and difficulties experienced	**D1** independently manage the project development process, seeking support and guidance where necessary
P2 prepare a project specification [IE2, IE4, TW1, EP4]	**M2** use a wide range of techniques and selection criteria to justify the chosen option	**D2** evaluate the whole project development process, making recommendations for improvements.
P3 agree and prepare the procedures that will be followed when implementing the project [EP1]	**M3** evaluate the project solution and suggest improvements	
P4 use appropriate techniques to evaluate three potential solutions and select the best option for development [CT1]	**M4** present coherent and well-structured development records and final project report.	
P5 outline the project solution and plan its implementation [RL2]		
P6 monitor and record achievement over the life cycle of the project		
P7 implement the plan and produce the project solution [RL2, SM1]		
P8 check the solution conforms to the project specification		
P9 prepare and deliver a presentation to a small group outlining the project specification and proposed solution [SM7]		

Grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P10 present a written project report.		

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

Centres will need to carefully consider how the unit content and required process skills are to be delivered. In particular, the administrative, planning, implementation and presentation skills and knowledge needs to be delivered before or in tandem with the time period allocated for the whole project. Some aspects of the content may be supported by other units in the programme, such as communications, mathematical and engineering principles and therefore may have already been covered. However, a large proportion of the process skills and knowledge will need to be delivered or reinforced during the early stages of project delivery. Ideally, learners should have the knowledge and skills associated with the content for learning outcomes 1, 2 and 3 before they start specifying, planning or implementing the project. Report writing and presentation skills could be left until later, but opportunities to gain, use and practise these skills may well have already occurred in earlier units.

Tutors could start delivery of the unit by providing an overview of the whole project process and identifying the major milestones that need to be met in order to satisfy the assessment criteria. Providing learners with a route map/overview of what is required, when it is required and the project assessment strategy enables learners to formulate clear objectives and will aid their planning and delivery of the project outcome. The use and importance of the logbook as a source of evidence and living history of the project should also be emphasised and learners should be encouraged to open logbooks at this early stage and start to record events from the outset. A portfolio of primary research material should also be introduced at this stage, where information collected from the internet, literature and journals may be used for assessment evidence and as a source of reference when producing the final written report. The unit requires learners to take a considerable amount of responsibility for their own work – it is important to recognise this and ensure that learners are aware of the need to organise and plan their work from the beginning.

Next, the process skills and knowledge may be delivered that enable learners to consider and select an appropriate project, after carrying out a feasibility study. Learners should be encouraged to try and select their own suitable project, or obtain one from their place of work/external customer, in preference to being given one by their tutor. Learners, who select their own project tend to have an interest in the subject and therefore require little encouragement to sustain progress throughout the whole life of the project and so produce a worthwhile outcome.

The advantages/disadvantages of a group project should also be clearly spelled out to learners, before they make their choice, with strong recommendations for them to undertake an individual project. If learners really desire to work in a team they will need to agree the topic with the other team members. It will also be essential to make sure that each team member has clear responsibilities and that everyone makes a contribution to the end result during every process/stage of the project. All individual team members must be clear about who is responsible and accountable for each aspect of the work. Each member of the team must produce their own evidence against all the criteria in the unit, as evidence cannot be shared. Regular progress meetings with the project supervisor (for example tutor and/or employer) are essential and a record must be kept of what is said and agreed. Each member of the team must be accountable for their own project outcome and solution.

The delivery of the skills and knowledge associated with producing a project specification and selecting a project option should then be delivered, with sufficient time being allocated for learners to produce their specification and select their most favourable option. Learners will require varying degrees of help at this stage and tutors should carefully monitor individual learner progress and achievement.

In order for learners to achieve learning outcome 2, tutors will need to introduce or recap on the planning and monitoring techniques required to implement the project solution and monitor and record achievement over the life cycle of the project. This outcome might best be delivered in a resource centre, where there is both library and computer access. Again, the amount of time spent with individual learners will vary according to their skill and proficiency in the use of planning and monitoring tools. Emphasis should be placed on the fact that the production of a long-term plan is not the end of the process and that there will need to be continual monitoring and modification/amendment of plans as events dictate.

The delivery of learning outcome 3, from the tutor's perspective, is mainly concerned with monitoring learner progress and acting as a point of reference for all things associated with the implementation and successful completion of the project solution. However, there is also a need to check with individual learners that they have planned their implementation process, in accordance with agreed procedures, particularly with respect to budgetary constraints and resource/time limitations. Throughout the unit, but particularly during the implementation phase in workshops or laboratories, the tutor should ensure that learners are made aware of all relevant health and safety issues, both for the implementation process and the product solution. No learner should use any equipment or process that they have not been trained to use, nor should they be allowed to use machinery without appropriate levels of supervision. To ensure a satisfactory outcome/solution, learners will need to liaise with the customer and/or the project tutor and, if appropriate, other members of the team throughout all stages of the project. As the project outcome and solution are assessed against the project specification it is important that the tutor guides each learner to ensure completion of their project. Learners should also be encouraged to consider the environmental impact/sustainability issues of their project solutions and the effect of national/international standards and legislation.

The process skills and knowledge needed by learners to prepare and deliver a presentation and prepare and present a written report might best be started while learners are still engaged with the implementation of their project solution. Learners may already have been introduced to the use of presentation aids and the format and methodology of report writing, so again the amount of formal input required for individual learners will vary. Tutors need to be aware of both group and individual needs and offer help and advice accordingly. Learners should be able to use a range of computer software packages and electronic and manual equipment necessary to both prepare and present the presentation and final written report. Clear guidelines should be given to learners on the standards expected to meet the assessment criteria for learning outcome 4. Whether the presentation or the written report is presented first will depend on centre arrangements. It is often the case that the presentation is completed before the written report is submitted. This has the added advantage of being able to inform the learner of any additional considerations that may need to be taken into account in order to improve the worth of the final project solution, as evidenced through the project report and any physical artefacts needed to demonstrate the solution. The importance of maintaining the logbook and having the logbook and other portfolio evidence ready for final scrutiny should also be emphasised at some time before submission of the final report.

Choosing an appropriate project

The end result of the project should be an engineered solution that is both relevant to the learner's field of study and that will draw upon what they have learned while studying the other units of their programme. The engineered solution may lead to some form of product or device. The end result could equally lead to a system of work, a process or a procedure or to a modification to an existing process or product. The best projects come from the initial identification of a genuine need or requirement.

Whatever type of project is undertaken, it is important to realise that the actual problem must be deliverable. Centres should allocate enough time to ensure that quality outcomes can be achieved against the project specification and be assessed. The project has to be feasible within the time available and, as project supervisor, the tutor should provide suitable guidance on this. Tutors may also need to help learners when they are in the process of finding a set of 'customer needs' for their project.

Examples of project outcomes for learners studying the mechanical pathway include:

- modification of a mechanical product
- specifying and designing a mechanical system
- testing a mechanical product.

Examples of possible project outcomes for learners studying the manufacturing pathway include:

- modification of a manufactured product or service
- designing and building a manufactured product
- testing a manufactured product or service.

Some examples of project outcomes for learners studying the operations and maintenance pathway include:

- modification of plant services
- designing and building an inspection/calibration test rig
- testing plant service systems or sub-systems.

For learners studying the electrical/electronic pathway examples of project outcomes could include:

- modification of an existing electronic/electrical product
- specifying, designing and building an integrated hardware/software system
- testing and evaluation of an electronic/electrical system or service
- comparison and evaluation of a range of electronic/electrical CAD tools and systems.

Some examples of possible project outcomes for learners studying the aerospace pathway include:

- modification of an aeronautical product
- specifying, evaluating and/or designing an aeronautical system or service
- testing an aeronautical product.

It is important to remember that learners are looking for a problem or task to be solved, not for a finished item as a starting point.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Whole-class teaching: • introduction to unit – explain project milestones and assessment strategy   • tour of access/use of centre library/learning centre/IT centre/workshops, throughout the life of the project   • introduction to the nature and use of logbooks as source of evidence of activities throughout the life of the project. Use of diaries/computer diaries.   *Learner activities*:   • open logbook and record what needs to be done, the project milestones and assessment strategy, possible research methods and record keeping methods.
Whole-class teaching: • present examples of past projects and/or project themes and outline advantages/disadvantages of group projects   • generation and stimulation of ideas – introduction to brainstorming and mind-mapping techniques. Learner participation in class brainstorming session   • learner activity, produce a mind-map of their individual ideas for a project, or for a project idea they may have been given by their employer.   *Group activity*:   • participate in small brain storming groups, to develop their individual ideas.   *Whole-class teaching*:   • initial concepts, feasibility of ideas.
Learner activity: • carry out a feasibility study of own/employer ideas/concepts for project subject and present findings.   *Whole-class teaching*:   • specification form and types according to project subject matter – technical, health and safety, environmental, legislative and resource considerations.   *Learner activity*:   • make first attempt at preparing own project specification.   *Whole-class teaching*:   • techniques/considerations for selecting best project solution option   • introduction to roles and responsibilities, reporting methods and resources that need to be considered when implementing project solution.   *Learner activity*:   • practise and use techniques and select best solution/s, from given scenarios   • produce and present an interim report containing the final project specification, the selected best option for the project solution and details of the procedures that will be adopted when implementing the project solution/outcome.

Topic and suggested assignments/activities and/assessment

Whole-class teaching/individual tuition:

- planning use of charts and scheduling techniques, software packages, setting priorities, resource planning, time planning.

Learner activity:

- using planning techniques (both hand and computer based) produce long-term plan (capable of modification) for implementation of own project outcome.

Whole-class teaching/individual tuition:

- monitoring and modifying plans and recording achievement, use of logbooks as a means of monitoring, recording and providing evidence of achievement, computer diaries, etc.

Learner activity:

- implement plan and produce project solution/outcome in accordance with agreed specification, appropriate techniques for generating solutions and agreed procedures concerned with the scope of project

- record and modify plans in the light of experience, re-evaluate progress and success on regular occasions and conscientiously record all necessary actions, changes of plan, technical and analytical aspects, findings and conclusions.

Whole-class teaching/individual tuition:

- tutor to act as facilitator, resource provider and point of reference for all problems associated with delivery of project outcome and for the regular monitoring and review of individual progress.

Group teaching and demonstration:

- presentation aids and techniques – use of audio-visual presentation aids. Techniques to consider when preparing notes/written material for presentation. Presentation of project report/deliverables. Written report style, protocols and structure. Use of IT/software packages for preparing report.

Learner activity:

- practice preparation of presentation aids and under supervision, practise use of a range of audio-visual equipment

- prepare presentation and practise delivery to piers or self

- prepare written report, seeking guidance from tutor, as necessary

- deliver presentation to selected audience at time dictated by the centre

- deliver project report and logbook and/or portfolio/artefacts as required for assessment by tutor.

Feedback to learners, unit evaluation and close.

Assessment

Assessment of this unit will be based primarily on the learner's logbook/diary and other evidence of the work carried out and the processes adopted. Use will also be made of the learner's specification document, presentation and technical project report.

It should be noted that the logbook/diary is intended to be a working document and should contain the learner's notes and records as they are made at the time. It does not need to be a well-presented/neat document, but should be an effective tool to capture events and information as and when they happen and provide a useful source of reference for the learner when preparing their presentation and final written report. The tutor/project supervisor could also annotate the logbook/diary to indicate and record their observations and interactions with the learner, for example use of ICT, the logical formulation of ideas, use of technical knowledge, analysis and the outcomes/recommendations from these meetings.

Learners will need to include, possibly as an annexe (under separate cover) to the technical report, their own sketches, drawings/circuit diagrams, notes, lists, charts, raw calculations etc to support their project report findings. Appropriate methods of presentation and management of the total evidence package should be discussed and used by the learner.

Learners will need guidance on the way to write a formal technical report and this, together with other requirements of the unit, provides opportunities for learners to practice and demonstrate their personal, learning and thinking skills (PLTS) and functional skills. Learners may well be working closely with their own company/employer on their project and may be required to adopt the company's own 'house style' for the presentation of the report. This would of course be acceptable, since it will be in line with standard industry practice and report writing protocols and because it is the content of the report (ie its technical information, logical presentation methods and coherence) that is assessed, not its style.

Care should be taken to identify learners who may be genuinely terrified of standing in front of a group to make a presentation. The experience of making such a presentation is valuable and is recommended. However, as a minimum, learners only have to make an informal presentation to one or two people (which would reflect the typical minimum required in employment at this level) to achieve the unit. The presentation offers another opportunity for evidence towards selected PLTS and functional skills.

As many of the activities undertaken by learners will be practical and skills-based, it is important to think about the method of capturing and presenting such evidence for assessment purposes. Often, witness testimony or records of tutor observation will be necessary. Copies of these will need to be placed in the final portfolio of evidence.

In order to achieve P1, learners will need to prepare and maintain project records from initial concepts through to solution that take account of and record changing situations. Evidence could be collected by tutors from the learner's logbook. It is suggested that learners prepare and submit a written project specification for scrutiny in order to provide evidence for the achievement of P2 (ie that they have produced a specification to an acceptable standard). As part of the project specification learners could also include written evidence for the procedures (P3) that they have agreed to follow, after discussion with their tutor, when implementing their project solution. Particular emphasis should be placed on ensuring that learners consider budgetary constraints and resource/time limitations. Evidence for the achievement of P4, concerning the evaluation of potential solutions and the techniques used to select the best option, might best be obtained from scrutiny of the learner's logbook, or again form part of the written project specification/interim report.

To achieve learning outcome 2 learners will need to outline their chosen project solution and plan for its implementation (P5), in addition to monitoring and recording achievement over the life cycle of the project (P6). Evidence of achievement will again be through the logbook. Tutors may also wish to record some of this performance as an observation record or use witness statements. The observations might well take place when learners are using computer-aided or manual planning tools in the learning centre. Additional evidence for P6 might come from the annotation of planning documentation or plans in the learner's logbook, that show the changing situations.

Learning outcome 3 is concerned primarily, with the implementation of the project solution while adhering to agreed procedures (P7) and checking throughout the implementation phase that the solution produced conforms with the project specification (P8). The type of project chosen by the learner will, to a degree, dictate the methods used to provide evidence of achievement. Learners who are engaged on design/build or physical testing/modification type projects on a system or component, will be spending most of their project implementation phase in workshops and/or laboratories. Therefore, tutors will need evidence from observation records and from the physical solution itself. Evidence of achievement of P7 for those learners engaged in the production of a modified procedure/service, will provide evidence of achievement via their logbook records, presentation and final written report.

No matter what type of project learners choose, the primary source of evidence for achievement of P8 is likely to be the learner's logbook, where comparisons can be made with the agreed procedures to see whether or not learners abided by these procedures when producing their project solution.

In order to meet learning outcome 4, learners will need to prepare and deliver a presentation outlining their project specification and proposed solution to a small group (P9) and present a written project report with supporting documentation (P10). Evidence for P9 will be obtained from a combination of hard copies of the presentation, such as handouts, slides etc and witness statements, together with the results of observation records from those present. The evidence for the achievement of P10 will come from the written report itself. Clear guidelines as to what is expected need to be given to learners well before the submission of their report.

To achieve M1, learners need to be able to work with greater autonomy and will have produced, and kept to, a workable plan. This will be demonstrated by their ability to maintain records throughout the project that are detailed, concurrent and clearly show progress made and the difficulties experienced. For M2 learners will need to have arrived at their project choice having used a wide range of techniques and from the use of these be able to justify their chosen option. The range of techniques used will need to show both statistical and graphical comparison methods for the potential solutions. Evidence will come from the learner's logbook and/or from the submitted written specification/interim report, (as was the case for achievement of P3).

Evidence for the achievement of M3, will come from observation records (particularly for design and build type solutions), scrutiny of logbook records and from the learner's reflections, written in the final report. It is expected that having evaluated their solution against the specification and/or from field evaluation and customer feedback, learners will then be able to suggest improvements that genuinely enhance the value of their project solution. Learners will have to present coherent and well-structured development records and final project report to achieve M4. The report structure is expected to adhere to standard technical report writing protocols, in order to achieve the criteria. The development records are likely to be included, as part of the learner's logbook and this should be submitted for final scrutiny, at the same time as the report.

To achieve a distinction, learners will have been able to work consistently towards a successful outcome and in doing so they will have independently managed the project development process, seeking support and guidance where necessary (D1). They will have shown the ability to reflect on their work throughout the project. Through this, they will have been able to evaluate the whole of the project development process and provide suggestions as to what they would have done differently to make improvements (D2). The evidence for both criteria is likely to come from the logbook and portfolio notes with the addition of witness statements and observation records for D1 and a separate written statement or statement in the final report, clearly evaluating the project making recommendations for improvements for D2.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the assessment and grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, M1	Prepare and maintain project records	Tutor to scrutinise learner's project records and/or have completed observation record or have available independent witness testimony.	Through scrutiny of learner's logbook, observation records and/or witness testimony. Detailed and concurrent records need to be demonstrated to achieve M1.
P2, P3, P4, M2	Project specification and selection of best project option	Tutor to consider submitted work and scrutinise learner records and/or take account of observation records or witness testimony.	Marked submission of project specification to acceptable standard, including written procedures to be adopted and evidence for the evaluation of solution. A wide range of statistical and graphical comparison methods demonstrated to meet criterion M2.
P5, P6	Production of project plan and monitor project over its lifecycle	Tutor to scrutinise project records and take account of observation records or witness testimony.	Scrutinise learner's long-term plans and logbook, identify and sanction achievement and changes made to plan, over the life of the project.
P7, P8, M3	Implement the project and produce the project solution	Tutor to observe leaner progress in the implementation of project plan and in the production of project solution.	Through scrutiny of learner's logbooks and observation records for implementation of project solution and written/observational evidence for evaluation of solution in order to meet M3 criterion.
P9, P10, M4	Presenting the project outcome	Observation of oral presentation and consideration of written report and other project records and deliverables.	Through observation records and written oral presentation material and the marking of the final written report and consideration of all other project deliverables. Identification of well-structured and coherent development records and final report in order to meet M4.
D1, D2	Independently manage and critically evaluate the whole project	Tutor/supervisor observation records or independent witness statements and take account of learners project records and written submissions.	Scrutinise learner's logbook and take account of observation records (D1) and mark written submission (D2).

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC Engineering sector suite. This unit has particular links with the following unit titles in the Engineering suite:

Level 1	Level 2	Level 3
		Communications for Engineering Technicians
		Commercial Aspects of Engineering Organisations

This unit contributes towards the knowledge and understanding for the Level 3 National Occupational Standards in Engineering Leadership, particularly:

● Unit 4: Scheduled Engineering Activities

● Unit 5: Obtain Resources for Engineering Activities

● Unit 7: Rectify Engineering Problems.

It also supports and contributes towards knowledge and understanding for the Level 3 National Occupational Standards in Project Management, particularly:

● Unit 4: Prepare a Project Brief

● Unit 10: Develop Operational Objectives for the Project

● Unit 11: Prepare the Specification of Requirements

● Unit 15: Specify Activities for Project Schedules

● Unit 17: Develop a Detailed Schedule for the Project.

Essential resources

Learners will need access to a wide variety of physical resources, dependent on the type of project they pursue. Many of these resources are detailed within the other units in the qualification. There is also a need to provide some form of access to audio-visual aids as well as access to libraries and computer aided learning centres. Learners may also require access to workshops, laboratories and specialist catalogues and other documentation. Centres should also subscribe to engineering journals and stock other useful literature, specific to the branches of engineering being covered.

Employer engagement and vocational contexts

Employer-led vocational projects need to be encouraged as they bring a sense of realism and purpose to the whole project process and they tend to better motivate learners. Awareness evenings, or similar, could usefully be arranged to encourage employer participation in setting suitable project subjects for learners. Additionally the topic of allocating employer driven projects to learners (employed or otherwise), could be raised at the faculties industrial focus committee meetings or at some other appropriate centre forum with employers.

There are a range of organisations that may be able help centres engage and involve local employers in the delivery of this unit, for example:

- Work Experience/Workplace learning frameworks – Centre for Education and Industry (CEI, University of Warwick) – www.warwick.ac.uk/wie/cei
- Learning and Skills Network – www.vocationallearning.org.uk
- Network for Science, Technology, Engineering and Maths Network Ambassadors Scheme – www.stemnet.org.uk
- National Education and Business Partnership Network – www.nebpn.org
- Local, regional Business links – www.businesslink.gov.uk
- Work-based learning guidance – www.aimhighersw.ac.uk/wbl.htm

Indicative reading for learners

Textbooks

Boyce A, Cooke E, Jones R and Weatherill B – *Edexcel* BTEC *Level 3 National Engineering Student Book* (Pearson, 2010) ISBN 9781846907241

Boyce A, Cooke E, Jones R and Weatherill B – *Edexcel* BTEC *Level 3 National Engineering Teaching Resource Pack* (Pearson, 2010) ISBN 9781846907265

Lock D – *Project Management* (Gower Publishing, 2003) ISBN 9780566085512

Melton Trish – *Project Management Toolkit, the Basics for Project Success* (Butterworth-Heinemann, 2007) ISBN 9780750684408

Melton Trish – *Real Project Planning: Developing a Project Development Strategy* (Butterworth-Heinemann, 2007) ISBN 9780750684729

Project Management Institute – *A Guide to the Project Management Body of Knowledge* (Project Management Institute, 2008) ISBN 9781933890517

Smith N J – *Engineering Project Management* (Blackwell Publishing, 2007) ISBN 9781405168021

Tooley M and Dingle L – *BTEC National Engineering, 2nd Edition* (Newnes, 2007) ISBN 9780750685214

Delivery of personal, learning and thinking skills

The table below identifies the opportunities for personal, learning and thinking skills (PLTS) that have been included within the pass assessment criteria of this unit.

Skill	When learners are ...
Independent enquirers	carrying out research in order to produce a project solution analyse and evaluation information, when considering suitable project subject matter, upon which to base a specification
Creative thinkers	generating ideas and exploring possibilities for a suitable project subject and solution
Reflective learners	set goals and review progress when planning their project and implementing their project solution
Team workers	collaborating with their project supervisor/client when producing their project technical specification
Self-managers	organising their time and resources to produce and present their project solution work towards goals and show commitment and manage their emotions, when preparing and presenting their oral presentation and written report
Effective participators	discussing issues of concern and seeking resolutions, when considering and agreeing procedures for the implementation of their project propose practical ways forward, when having to adjust implementation plans in the light of experience.

Although PLTS are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
Independent enquirers	analysing and evaluating information and support conclusions and arguments for the entire project process
Creative thinkers	trying out new solutions/alternatives when considering the best project solution
Reflective learners	evaluating their project solution and deciding on a modified implementation strategy
Team workers	engaged on group project work, where they need to collaborate on the apportionment of work, reach agreement on their own goals and objectives to satisfy the project assessment criteria and take responsibility for their own part of the group assignment
Self-managers	engaged in implementing their project solution and having to overcome challenges and show flexibility when implementation process does not go to plan
Effective participators	identifying improvements to their project solution that will be of benefit to their company/customer.

● Functional Skills – Level 2

Skill	When learners are …
ICT – Use ICT systems	
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	using computer-based techniques to plan an engineering project
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	using ICT to research, plan, monitor and implement an engineering project
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: ● text and tables ● images ● numbers ● records	producing a report on the outcomes of the project ready for presentation
Present information in ways that are fit for purpose and audience	producing a report on the outcomes of the project ready for presentation
Mathematics	
Identify the situation or problem and the mathematical methods needed to tackle it	designing a solution to an engineering problem
Select and apply a range of skills to find solutions	designing a solution to an engineering problem
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	working in a group when planning, monitoring and implementing a project solution presenting a final project solution
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	researching the project and possible solutions
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	producing a report on the outcomes of the project ready for presentation.