Guidelines for Work-based Education forming part of the educational base of a Chartered Engineer

1. Background

These guidelines cover *work-based education* as part of an *accredited degree programme* and *work-based education* as part of *Further Learning*. Definitions of the terms used in the guidelines are given in Appendix C.

1.1 Further Learning – Work-based education

- A BEng graduate has to acquire additional knowledge that is recognised as academically equivalent to masters-level work, in order to have the 'educational' base' required by EC(UK) to become a chartered engineer. *Further Learning* is the term for this.
- *Further Learning* is the acquisition of knowledge either through *work-based education* or through formal education such as an MSc programme undertaken at a university or through a combination of formal education and *work based education*.
- The *work-based education* has to be assessed in a manner that is comparable to the assessment of work in a university. Assessment can be carried out by an academic or by an employer provided the assessor has had training approved by the Institutions.
- *Work based education* includes a period of private study
- Without this *work-based education*, an engineer who has a BEng can still progress to be chartered through the *Technical Report Route* irrespective of the level of educational base held.
- The benefits to the individual of completing *Further Learning* are
    - the opportunity to develop critical thinking and research skills that are considered highly beneficial for engineers.
    - the time to chartership is less than the time taken for the *Technical Report Route* because of the elements of private study and structured education.
    - the individual knowledge is broadened because of the element of private study
- The benefits to the employer falls into two categories
    - the development of the individual – i.e. what benefits the individual is returned as benefit to the employer
    - the benefit of the research or development work undertaken by the individual that is the assessed work. This might be the case if this work is directed by the employer; it might also be the case if the employee attends an outside programme that is of interest to the employer.

1.2 Degree Programme – Work-based education

- It is possible to accredit *work-based education* that is designed as part of an *accredited degree programme*.

- *Work-based education* in a degree programme can include work placements, for example, a sandwich course, and vacation placements, and work placements as part of a module.
- A degree programme is made up of periods of learning which are assigned credits. An undergraduate year (usually thirty weeks of formal education) is equivalent to 120 credits. The credits for *work-based education* are different because the student is developing professionally while acquiring knowledge in the work place.
- The benefit to the individual is the opportunity to acquire knowledge whilst applying that knowledge in the work place.
- The benefit to the university is engagement with industry and the development of the individual.

2. Introduction

These guidelines cover *work-based education* that forms part of the educational base of a Chartered Engineer. This can either be *Further Learning* for a graduate with an accredited degree or a module within an *accredited degree programme* which is taken after completion of two (or three in the case of Scotland) years of the degree programme. The learner (the graduate or student) then has sufficient knowledge and understanding of the underlying engineering and scientific principles to successfully complete the period of *work-based education* at the right level of study.

2.1 Work-based education as part of an accredited degree programme (undergraduate)

This deals with *work-based education* modules that are integrated into an *accredited degree programme*. Sandwich placements, vacation placements and other forms of industrial engagement can be included provided they meet the principles of *work-based education* described in the sections on Process, Assessment and Learning Plan and take place after the end of the second year, or later, of academic teaching (year three in Scotland).

Work-based education modules have to occur between the end of second year (third year in Scotland) and graduation. They have to meet the principles described in sections on Process and Assessment, and have an individual *Learning Plan* for each student. The learning outcomes (Appendix A) and the appropriate level of competency (Appendix B) have to fit within the *accredited degree programme*. A *work based education* module is a more intense learning experience than a placement.

The assessment is based on a **portfolio of evidence** including an explanation to place the evidence in context, and how the key learning outcomes were achieved, a number of **assignments that test the knowledge and understanding and the ability to apply that knowledge**, and an **oral presentation**.

2.2 Work-based education as part of Further Learning (graduate)

Work-based education may be the whole or part of an *Employer Managed Further Learning Scheme* or part of an *accredited MSc programme*. A *Learning Plan* has to be created for the scheme or programme and it has to be designed so that a number of learning outcomes (Appendix A) can be achieved at the level of competency given in Appendix B.

The assessment is based on a **portfolio of evidence** including an explanation to place the evidence in context and how the key learning outcomes were achieved, a number of **assignments that test the knowledge and understanding and the ability to apply that knowledge**, and an **oral presentation**.

3. Process

The workplace is the place of education. It provides the opportunity for acquiring further knowledge. The learning process is experiential and the assessment is based on evidence of progress and achievement through problem based projects.

It is a partnership between the learner and the organisation in which the learning takes place. If the *work-based education* forms part of an *accredited degree programme* then the partnership includes the university at which the student is registered; if it is part of *Further Learning* then the partnership will include the assessor who could be an academic or someone from the organisation who has received appropriate training and is recognized by the relevant Institution.

The mode of delivery is flexible and reflects the opportunities to learn within the organisation. It can be supported by e-learning and distance learning. It must be relevant hence the need to approve a *Learning Plan* that includes learning outcomes that meet the JBM guidelines and take into account the learner's prior knowledge and experience.

4. Assessment

The assessment shall be based on four pieces of work:-

- The learner shall assemble a **portfolio of evidence** with an introduction to explain the context of the evidence and the key learning outcomes achieved. This portfolio of evidence can include design calculations, feasibility reports, forensic reports, ground investigation reports, environmental reports, option analyses, and risk analyses.
- There shall be sufficient **assignments** to test the learner's knowledge and understanding of their learning placed in the work place context, and the skills they have developed. The mastery of those skills will be used to assess the level of competency. It is important to assess the learner's critical thinking skills. These assignments shall be phased through the programme of learning to ensure that their progress is satisfactory. These assignments can take the form of tests, design exercises, reports, application of solutions in an alternative environment and interviews. They are in addition to the normal day to day work.
- The assessment shall include an **oral assessment** to ensure that the learner fully understands the outcome of their learning. This could take the form of a presentation to the assessor followed by questions or an interview by the assessor.
- The learner shall **reflect** on what has been learnt and how it could have been improved to assess whether the learner understands the learning process.

5. Learning Outcomes and Competency Levels

The learning outcomes and competency levels are taken from JBM guidelines and are presented in Appendices A and B. Note that not all learning outcomes have to be achieved because the period of learning may be part of an *accredited degree programme* or part of *Further Learning*.

6. Learning Plan

The *learning plan* is a learner centered programme of learning and assessment.

The *learning plan* must include:-

- A statement of the learning outcomes the learner has already achieved and at what level of competency.
- A specification of the learning outcomes the learner is expected to achieve and at what level of competency.
- A statement on the evidence required to demonstrate that the outcomes have been achieved.
- A statement on the methods of assessment, both formative and summative.
- Agreed milestones of assessment.
- The support the learner will have from the organisation in which the learning takes place, and, if the learning is part of an *accredited degree programme*, the support within the university.
- The names of the industrial supervisor and assessor, either an academic or an industrial assessor.

It must take into account any prior learning such as the knowledge gained by a graduate with an *accredited degree* or knowledge gained through *work-based education* with another employer. An example of a *learning plan* is given in Appendix C.

7. The time to complete Further Learning

Further Learning and *degree programmes* are designed so that *learning outcomes* are achieved at a certain levels of competency. *Degree programmes* are a form of formal education that is built up from credits of learning. A credit is notionally ten hours of work including formal and informal learning. The time taken for *work based education* will depend on the opportunities to acquire knowledge in the work place.

The number of credits assigned to *work based education* will depend on the type of work being undertaken by the learner and the opportunity to acquire knowledge.

- A structured work based module that forms part of an accredited degree programme could last for three months and would be equivalent to 25 credits (compared to fifty credits for a formal education). In this case the learner is focused on acquiring knowledge;
- A three month, full time placement, which has less structure than a module, would be equivalent to 15 credits. In this case the learner is acquiring knowledge as part of further learning and undergoing training as part of their initial professional development;
- And an *Employer Managed Scheme* would last between two and four years and could include work based education and structured modules of learning. In this case the learner is undergoing initial professional development and acquiring knowledge in the work place.

A formal education for *Further Learning* is 180 credits which, for a full time MSc programme, is one year. An *Employer Managed Scheme* which is entirely based on *work based education* would last four years (equivalent to 15 credits for three months). A combination of *work based education* and *structured modules* would last between two and four years. This compares with the *Technical Report Route* from 3.5 years to 4 years (IStrucE) and 7 years (ICE)

Figure 1 The educational base to become a Chartered Engineer

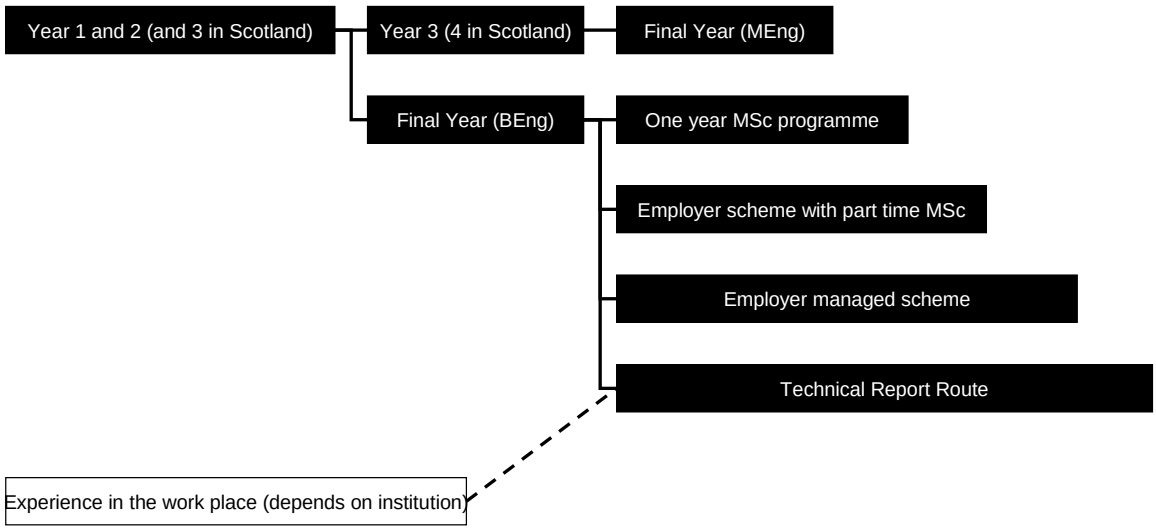
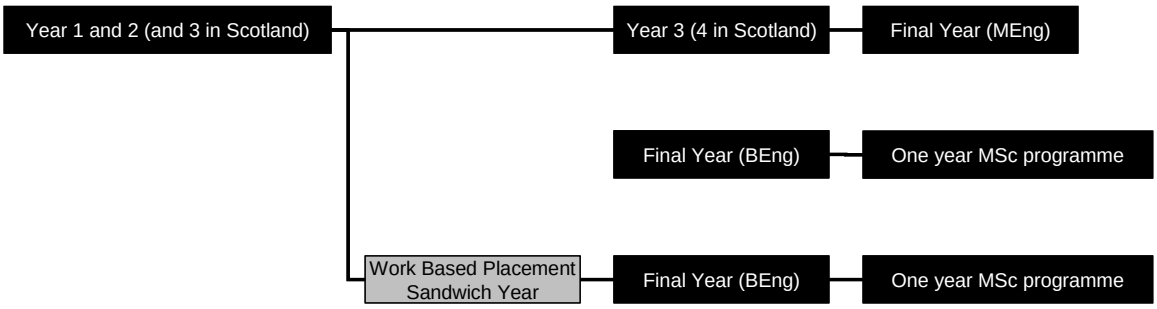


Figure 2 The position of placements as work based education (a) sandwich and (b) vacation placement



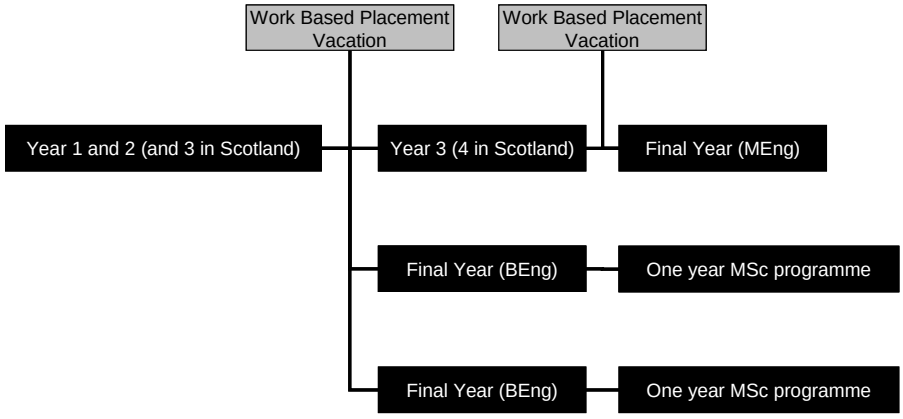
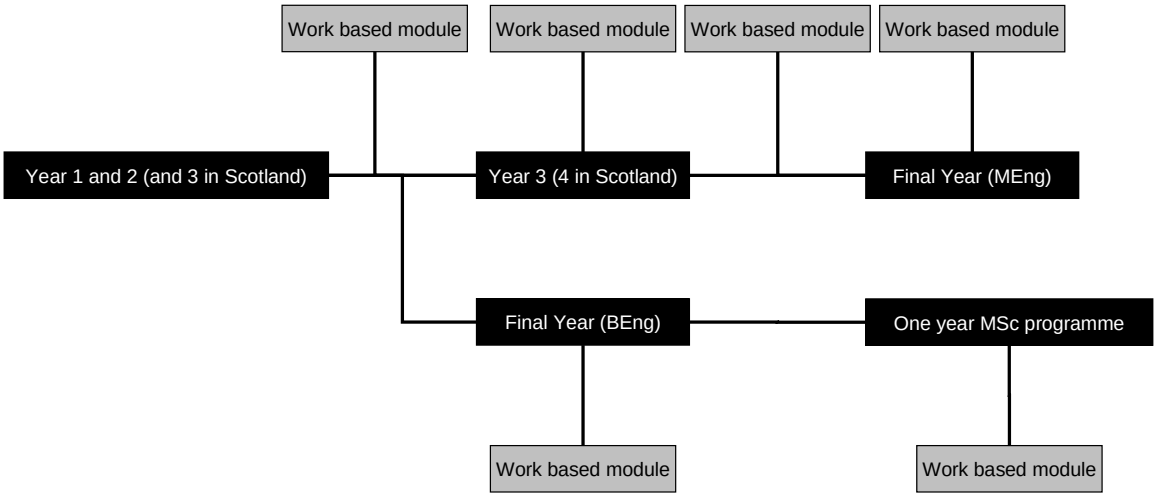


Figure 3 The position of modules as work based education (note that work based modules are expected to be more formally structured than work based placement)



Appendix A Learning Outcomes

General Learning Outcomes

Knowledge and Understanding	**Knowledge and understanding of essential facts, concepts, theories and principles of their engineering discipline, and its underpinning science and mathematics** Appreciation of the wider multidisciplinary engineering context and its underlying principles. Appreciate the social, environmental, ethical, economic and commercial considerations affecting the exercise of their engineering judgment.
Intellectual Abilities	Apply appropriate quantitative science and engineering tools to the analysis of problems. Demonstrate creative and innovative ability in the synthesis of solutions and in formulating designs. Able to comprehend the broad picture and thus work with an appropriate level of detail.
Practical Skills	Laboratories and workshops Work experience Individual and group project work Design work Development and use of computer software in design, analysis and control Evidence of group working and of participation in a major project
General Transferable Skills	Problem solving Communication Working with others Use of general IT facilities Information retrieval skills Planning self learning Improving performance

Specific Learning Outcomes in Engineering

Underpinning science and mathematics, and associated engineering disciplines, as defined by the relevant engineering institution	**Knowledge and understanding of scientific principles and methodology** Enable appreciation of its scientific and engineering context Understanding of historical, current, and future developments and technologies Knowledge and understanding of mathematical principles Enable them to apply mathematical methods, tools and notations proficiently in the analysis and solution of engineering problems; Ability to apply and integrate knowledge and understanding of other engineering disciplines
Engineering Analysis	Understanding of engineering principles; Ability to apply them to analyse key engineering processes Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modeling techniques; Ability to apply quantitative methods and computer software relevant to their engineering discipline, in order to solve engineering problems; Understanding of and ability to apply a systems approach to engineering

	problems.
Design	Investigate and define a problem and identify constraints including environmental and sustainability limitations, health and safety and risk assessment issues; Understand customer and user needs and the importance of considerations such as aesthetics; Identify and manage cost drivers; Use creativity to establish innovative solutions; Ensure fitness for purpose for all aspects of the problem including production, operation, maintenance and disposal; Manage the design process and evaluate outcomes.
Economic, social and environmental context	Knowledge and understanding of commercial and economic context of engineering processes Knowledge of management techniques which may be used to achieve engineering objectives within that context; Understanding of the requirement for engineering activities to promote sustainable development; Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues; Understanding of the need for a high level of professional and ethical conduct in engineering.
Engineering Practice	Knowledge of characteristics of particular materials, equipment, processes, or products; Workshop and laboratory skills; Understanding of contexts in which engineering knowledge can be applied (e.g. operations and management, technology development, etc.); Understanding use of technical literature and other information sources; Awareness of nature of intellectual property and contractual issues; Understanding of appropriate codes of practice and industry standards; Awareness of quality issues; Ability to work with technical uncertainty.

Appendix B Level of competency

Integrated within an *accredited degree programme* (after two years study (or three years in Scotland)

The level of competency to be achieved if the *work based education* occurs during the third year of a degree programme (after two years of study (or three years in Scotland) on an accredited degree programme) are:-

- An ability to critically review, consolidate, and extend a systematic and coherent body of knowledge.
- An ability to utilise highly specialised technical or scholastic skills across an area of study.
- An ability to utilise research skills.
- And an ability to critically evaluate new information, concepts and evidence from a range of sources

Integrated within the final year of an *accredited MEng programme* or within an *accredited MSc programme* or part of a *employer managed scheme*

The level of competency to be achieved if the *work based education* occurs during the fourth year of an *accredited degree programme* (after three years of study (or four years in Scotland) on an accredited degree programme) or as part of an *accredited MSc programme* or as part of an employer managed scheme are:-

- An ability to display mastery of a complex and specialised area.
- And an ability to demonstrate expertise in highly specialised and advanced technical, professional and/or research skills.

Appendix C Definitions

Learning	**The process of acquiring knowledge or skills**
Learner	A student following a formal education; a graduate following a planned programme of educational activity in the workplace
Education	Acquisition of knowledge through planned activity
Training	Acquisition of skills through planned activity
Work based learning	Learning that takes place in the work place post acquisition of a qualification
Work-based education	Acquisition of knowledge in the work place through planned activity, such as during a sandwich year
Work based training	Acquisition of vocational skills through planned activity in the work place
Learning outcomes	The specific skills or knowledge that a learner should be able to demonstrate after completing a period of training or education
Lifelong learning	The acquisition of skills or knowledge that takes place throughout a graduate's career
Module	A self contained period of study
Structured Module	A module that is formally taught
Accredited degree programme	Degree programmes formally assessed by the JBM as meeting or contributing towards the required academic standards for Incorporated and Chartered Engineer educational bases.
Educational Base	The formal education qualifications needed to become an Incorporated or Chartered Engineer or Engineering Technician.
Degree programme	A formal period of learning that leads to the award of a degree
Credits	A measure of a period of learning. A formal period of education of ten credits is typically 100hrs of work which includes private study and timetabled contact hours. It is not possible to define the number of credits for work-based education because of the flexible nature of that education. However, it is anticipated that three months work-based education is equivalent to 30 credits
Formative exercises	Exercises that do not count towards the overall assessment of the learners ability but are used to give feedback and are, therefore, part of continuous improvement
Summative exercises	Exercises that count towards the overall assessment of the learner's ability.

Appendix D Developing a Learning Plan

This describes the process that could be used to develop a learning plan.

A1. Introduction

The *learning plan* is a learner centered programme of learning and assessment. It is developed by the learner in consultation with the Supervising Engineer and Assessor. Note that the learner could be a graduate on a Further Learning programme, a student on a placement that counts towards the degree, or a student on a work based module that counts towards the degree.

The aim of a *learning plan* is to enable the learner to plan to meet the learning outcomes at the appropriate level of competency. The learning outcomes are listed in Table A1; the levels of competency are listed in Appendix B. Table A1 lists the fifteen learning outcomes, examples of activities that could be undertaken and the evidence that is necessary to show that the outcomes have been achieved. The complete Table applies to a Further Learning programme for a learner aspiring to achieve IEng or CEng; it is a programme of activity that completes the educational base. Table A1a refers to the gap between the outcomes of an accredited Bachelors degree and an accredited Masters degree, that is, the learning needed to complete the educational base to become a Chartered Engineer. Table A1a could also be used as a guideline for an IEng learner who wishes to become CEng. Table A1b refers to the gap between the outcomes of an HNC/HND and an accredited Bachelors degree, that is, the learning needed to complete the educational base to become an Incorporated Engineer.

These guidelines refer to the development of a *learning plan* that forms all or part of a Further Learning programme. They can also be applied to work based education that forms part of a degree programme or to a placement as part of a degree programme or within the timescale of a degree programme (e.g. vacation employment).

A *learning plan* should include details of the people involved, the learning outcome(s) to be achieved, the skills and knowledge needed to achieve those outcomes and the evidence that will be required to demonstrate that the outcomes have been achieved.

Note that a learning outcome may be achieved by part of an activity, one activity or several activities.

A2. The Structure of the Learning Plan

Table A is an example of an outline of a learning plan. It is an agreement between the learner, the Supervising Engineer and the Assessor. It is recommended that this plan is developed by the learner.

A2.1 Details of Staff

This lists the details of the learner, the Supervising Engineer and the Assessor. Note that there may be more than one Assessor depending on the complexity of the programme and the range of expertise required. The Assessor could be an employee of the company, an academic or another professional engineer.

A2.2 Analysis of the Learner's Needs

This lists the outcomes that the learner is expected to achieve and the evidence needed to prove that the learner has achieved those outcomes. They are based on those found Column 1 in Table 1.

Details of the activity are given here. Note that this learning plan is designed for a single activity but could be extended to cover a number of activities. The single activity could be a taught course, a design report, a feasibility study, a project plan; that is an activity that is undertaken as part of the employment that provides an opportunity to develop knowledge and understanding.

The background knowledge needed to complete the work is used to assess the learner's current knowledge and skills and indentify any additional learning or training required. This additional learning or training could be part of the activity or some additional activity such as private study, a short course or induction programme,

The learning outcomes will be listed here. They will be derived from those listed in Table 1 but could be more detailed to reflect the nature of the activity. More detailed outcomes can be considered as objectives which allow the activity to be broken into elements that can be

assessed.
This learning plan can be considered as a mini project. Therefore there is a need to identify the resources required to complete the activity. There may be additional resources required to demonstrate that the learning outcomes have been achieved. This planning process may be considered as part of the learning process.
Private study is an essential component of further learning. This could include research into the activity to determine how other people complete this activity, to place the activity in context or to understand how the knowledge gained in carrying out this activity could be used in future. This last point is particularly important because it will be assessed at some point.
Contact Time is a key element in the Further Learning process. Direct contact with an experienced individual or group in a structured environment, such as a course, or any form of mentoring, is very beneficial in achieving a learning outcome. The Learning Plan should show where learning is achieved by Contact Time.

A2.3 The Assessment of learning outcomes

The assessment shall generally be based on four pieces of work:-

- The learner shall assemble a **portfolio of evidence** with an introduction to explain the context of the evidence and the key learning outcomes achieved. This portfolio of evidence can include design calculations, feasibility reports, forensic reports, ground investigation reports, environmental reports, option analyses, or risk analyses.

- There shall be sufficient **assignments** to test the learner's knowledge and understanding of their learning placed in the work place context, and the skills they have developed. The mastery of those skills will be used to assess the level of competency. It is important to assess the learner's critical thinking skills. These assignments shall be phased through the programme of learning to ensure that their progress is satisfactory. These assignments can take the form of tests, design exercises, reports, application of solutions in an alternative environment and interviews. They are in addition to the normal day to day work. The number of assignments will depend on the scale of the activity and the evidence needed to demonstrate that the learning outcomes have been achieved.

- The assessment shall include an **oral assessment** to ensure that the learner fully understands the outcome of their learning. This could take the form of a presentation to the assessor followed by questions or an interview by the assessor.

- The learner shall **reflect** on what has been learnt and how it could have been improved to assess whether the learner understands the learning process. This will be a statement on what has been learnt in undertaking the activity and what could have changed to enhance the learning experience.

A2.4 The Timetable

It is expected the learner will meet with the Supervising Engineer and undertake a number of assignments throughout the learning period. The number will depend on the scale and complexity of the activity.

A3 Record of Progress

Table B is an example of a review sheet and is a means of recording the progress of the learner. It allows the learner to maintain a record of meetings with the Supervising Engineer and to identify the evidence that is being collated. It can also be used to give feedback to the learner.

A4 Record of Completion

Table C is an example of a completion sheet which lists the evidence that has been used to show that the learning outcome(s) have been achieved. Each item that contributes to the portfolio of evidence and the assignments should be listed and signed off by the Supervising Engineer.

Table A An example of a learning plan
An agreement between the learner, the Supervising Engineering and the Assessor

1 Details of Staff

Student/Graduate	
Contact details	

Supervising Engineer	
Contact details	

Assessor(s)	
Contact details	

2 Analysis of the Learner's Needs

Activity	
Details of the activity	e.g. A brief description of the aims and objectives of the activity and the methodology by which they are going to be achieved.
Background knowledge needed to complete the activity	e.g. What does the learner need to know to complete the activity?
Additional learning or training needed to prepare for the activity	e.g. What knowledge does the learner have and what additional knowledge does the learner require?
Skills necessary to complete the activity	e.g. What skills should the learner have in order to complete the activity?
Additional skills training needed to prepare for the activity	e.g. What further additional skills training does the learner need to complete the activity?
Learning outcome(s)	e.g. This should list the learning outcomes that the learner is expected to achieve. It could be a detailed breakdown of the objectives that collectively achieve one or more of the learning outcomes listed in Table 1.
Resources needed to complete the activity	e.g. This should list the resources that are required to complete the activity
Additional resources needed to demonstrate the learning outcomes	e.g. These are additional resources needed to demonstrate that the learning outcomes have been achieved.
Private Study	e.g. background to the activity; examples of how the activity is used elsewhere; alternative solutions; how the knowledge gained in completing the activity could be applied in a different situation

3 The Assessment of Learning Outcomes

Portfolio	e.g. design calculations, feasibility reports, forensic reports, ground investigation reports, environmental reports, option analyses, or risk analyses
Assignments	e.g. tests, design exercises, reports, application of solutions in an alternative environment and interviews
Oral Assessment	e.g. A presentation to the assessor followed by questions or an interview by the assessor. How could the lessons be learnt in another situation?
Review of	e.g. What has been learnt in undertaking the activity? What could have

Learning	changed to enhance the learning experience?

4 Timetable for the Learning Outcomes to be achieved

Start Date	
Review Date	e.g. This could be dates of review meetings with the Supervising Engineer to monitor the progress
Dates of Assessment	e.g. The completion of assignments.
End Date	

Table B An Example of a Review Sheet
A sheet to record the progress of the learner

Learner	

Learning Outcome		
Activity		
Meeting with Supervising Engineer	**Date of meeting**	
	Items discussed	
	Recommendations for future work	
	Date of next meeting	
	Supervisor's signature	
	Learner's signature	
Assessments	**Date of assessment**	
	Form of assessment	
	Feedback	
	Assessors signature	

Table C An example of a completion sheet
A cover sheet to sign off the learning outcomes

Graduate	
Contact details	

Learning Outcome		
Portfolio	e.g. title of document	Signed
		Date
Assignments	e.g. title of assignment	Signed
		Date

Table A1 Suggestions on how the learning outcomes needed to complete the educational base to become a Chartered or Incorporated Engineer could be met

Table A1a The Chartered Engineer

Learning outcomes	Activity	Evidence	Assessment	Learning Time
CEng – 1 **The ability to integrate the knowledge and understanding across the whole course.**	▪ Produce a Further Learning Report (FLR) at the end of the programme summarising this integration. This report will also include reference to other learning outcomes set out below.	▪ Further Learning Report (FLR).	▪ Based on the standard of the report and presentation, including oral assessment.	▪ 5 days
CEng – 2 **A greater degree of industrial involvement through project work.**	▪ Brief given on a defined company-based problem with certain constraints and specified needs. Candidate has to identify data requirements, collect data, undertake analysis and to produce a report on findings.	▪ Quantitative and qualitative data, and report on findings	▪ Quality of data gathered, depth of analysis, quality of report and company presentation	▪ 4-5 days
CEng - 2 **A greater degree of industrial involvement through project work.**	▪ Investigate the effects of an alteration to a structure on ancillary trades and structural design, e.g. contract programme design implementation, Environmental and H&SW	▪ Report and presentation. ▪ Application to future work.	▪ Based on quality and content of report. ▪ Future reviews by management.	▪ Study/research 12days ▪ Analysis/report 5days
CEng – 3 **The ability to develop, monitor and update a plan of work to reflect a changing operating environment.**	▪ Research a new and developing project area such as CDM or EuroCodes, which is applicable to the workplace. ▪ 1 day course ▪ Self research	▪ Report and presentation. o Implications o implementation ▪ To chair a question and answer session	▪ Quality of the report and the oral assessment answers. ▪ Knowledgeable answers to questions are the key area of assessment; the report will not contribute as much.	▪ 1 day on course ▪ 5 days self-learning ▪ Time taken to produce results (approx 5 days)

Learning outcomes	Activity	Evidence	Assessment	Learning Time
CEng - 4 **The ability to monitor and adjust a personal programme of work and to learn independently.**	▪ Select a topic and research it. ▪ Develop a project plan leading to an outcome.	▪ Research ▪ Project Plan (what, when etc) ▪ Schedule	▪ Quality of project plan ▪ Achievement against programme ▪ Review of output (presentation, report/design exercise)	▪ 10 or more days depending on the agreed size of the project.
CEng – 5 **An understanding of team roles, and the ability to exercise leadership.**	▪ Staff Induction programme ▪ Attendance at Team meetings ▪ Team building course (work related) ▪ Role allocation ▪ Supervising others ▪ Managing others internal and external (e.g. graduate trainees, sub-contactors on site)	▪ Presentation on organisation/Departmental structure ▪ Minutes of meetings ▪ Appraisal/PQD reports.	▪ Performance of schedule – to time, on budget, Quality, H&SW, Environmental etc ▪ Discussion (Depth and breadth of inclusion)	▪ Training courses 5 days ▪ Preparation and production of presentation and discussion 4 days ▪ Management of others 5 days
CEng – 6 **The ability to learn new theories, concepts, methods, etc, in unfamiliar situations.**	▪ Inter departmental exchanges ▪ Technical training (including software) ▪ Specific project	▪ Output – material ▪ Written Report	▪ Quality and depth of knowledge ▪ Quality of the output material ▪ Review of written Report and other supporting material.	▪ Technical training – 3 days ▪ Contact time 5 – 10 days ▪ Analyse report and assessment 5 days
CEng – 7 **Knowledge of new and emerging technologies.**	▪ Read journal papers and conference papers on emerging technologies ▪ Design work and shadowing	▪ Test applicant ▪ Design and report	▪ Test applicant ▪ Design Assessed	▪ 15 days
CEng - 8 **Knowledge of mathematical and computer models**	▪ Select and use an industry standard mathematical and/or computer model to provide a required outcome. (e.g. 100 year flood outline using ISIS).	▪ A written report (e.g. challenge considerations, findings, confidence levels, limitations)	▪ Based on quality of reports, presentation and ensuing discussion.	▪ Depends on size of task in hand ▪ 5 days to select ▪ 2 days learning time for running and referencing model ▪ 3 days interpretation ▪ 2 days report writing

Learning outcomes	Activity	Evidence	Assessment	Learning Time
CEng – 9 An understanding of a wide range of concepts including some outside engineering.	▪ Attending seminars, (external and in-house) and research on a wide range of topics such as risk, economics, environment etc (as defined)	▪ Development of a project file/portfolio containing evidence of achievement on each topic area and reports focusing on how the topics studied can inform company practice in terms of applying new knowledge	▪ Quality of evidence and reports collected and presented, viva/ question and answers and application of new knowledge.	▪ 2.5 days per topic x 6 topics = 15 days
CEng - 10 Application of innovative design processes in unfamiliar situations.	▪ Select an appropriate solution and apply it in a new or time-limited situation. ▪ Apply standard solutions in a new way or a new solution for an existing problem.	▪ The task itself whether a design, a report on the build.	▪ Confirmation by project manager, site engineer.	▪ 5 days
CEng - 11 Extensive knowledge and understanding of management and business practices.	▪ To investigate and up-ate a company Quality Assurance policy in an area where it has experienced a high number of non-conformities. Candidates to propose new procedures as a result of research	▪ Presentation of Report and draft up-date of policy. Evidence of data gathering, analysis and recommendations for change to be contained in report.	▪ Acceptance by senior management and Quality Manager resulting in up-date being published and the resulting number of non-conformities being reduced.	▪ Two one day meetings with Quality Manager. ▪ Data gathering. 5 days ▪ Analysis of data 5 days ▪ Production of written report and revising policy documents.
CEng - 11 Extensive knowledge and understanding of management and business practices.	▪ Needs Analysis ▪ Internal CMS ▪ Assignments ▪ Tests ▪ Projects	▪ Reports ▪ Presentations ▪ Discussions ▪ Self-Evaluation	▪ Review of Reports ▪ Presentations ▪ Discussions ▪ Evaluation	▪ CMS 2days/m x 18 = 36 days ▪ On the job learning = 20 days

Learning outcomes	Activity	Evidence	Assessment	Learning Time
CEng – 12 **The ability to evaluate and balance commercial and safety risks.**	▪ Formal H& SW and commercial awareness training followed by a review of a project on which the trainee has worked.	▪ Certification on completion of training as a prerequisite to attempting the project. H&SW evaluative report and company presentation of findings.	▪ Based on quality of report and presentation.	▪ 5 days H& S and Commercial awareness training ▪ 15 days research and report writing
CEng – 13 **A thorough understanding of current engineering practice and its limitations.**	▪ Substantial experience (looking back over 3 years) ▪ Define scope of engineering practice e.g. impact of CDM changes resulting from new H&SW regulations. ▪ EIA on Environmental aspects	▪ Present an evaluative report and records ▪ Quarterly reports ▪ For example: o Changing legislation. CDM 2007 o Inherent risks elimination or reduction. o Safety records o Checking of individuals involved (interview) o Concept, design, tendering and contracts o Design out hazards	▪ Reports on aspects of evidence and analyses and ability to change. ▪ Presentation and recommendations (future checks) ▪ Discussion ▪ Evaluation of future trends.	▪ 15 – 20 days (over 3 years) ▪ Experience Report 1 day ▪ Preparation and presentation 1 day.
CEng – 14 **Extensive knowledge and understanding of a wide range of engineering materials and components.**	▪ Structured visits to quarries, concrete batching plants, steel mills and fabrication yards to appraise engineering specifications and their importance and relevance to a companies procurement department.	▪ Interrogate existing specifications and enhance/re-write to ensure that appropriate materials and components are procured.	▪ Revised specifications used by Head of Procurement Department to obtain materials and sub-contractors containing best value.	▪ Three days of structured visits. ▪ 10 days for reviewing/re-writing specifications through reading and discussions with senior managers.

Learning outcomes	Activity	Evidence	Assessment	Learning Time
CEng – 15 **The application of engineering techniques in a range of commercial and industrial constraints.**	▪ For example: o Engineering options; o Environmental options; o Sustainable options; o Financial issues – whole life costs o Asset/maintenance costs. ▪ Work to be related back to the candidate's academic study.	▪ A range of evidential material that could include, for example: o Needs o Standards o Engineering options o Initial costs o Long-term costs o Grant/partnerships/environmental spectrum. ▪ Records to be collected e.g evidence from the construction team.	▪ Written Report ▪ Presentation ▪ Short-term early checks on performance ▪ An element of testing ▪ PDP/appraisals ▪ Discussion	▪ 15 days ▪ Report 1 day ▪ Presentation 1 day

Table A1a The Incorporated Engineer (needs editing)

Learning outcomes	Activity	Evidence	Assessment	Learning time
IEng - 1 **The ability to monitor, interpret and apply the results of analysis and modelling in order to bring about continuous improvement.**	Company related investigation such as techniques used to build a reinforced concrete retaining wall. Trainee to research the facts, can it be done differently, range of materials/alternatives / suggested improvements.	▪ Data - Evaluation/analysis of data. ▪ Written Report ▪ Publication of technical paper on the company Intranet	▪ Quality of report. ▪ Thinking that has gone into the investigatory output including analysis and recommendations	▪ 5 days.
IEng - 2 **The ability to apply quantative methods and computer software relevant to civil engineering, frequently within a multidisciplinary context.**	e.g. ▪ CAD course ▪ LSS (ground modeling) ▪ Project/plan packages ▪ Estimation ▪ Databases etc	▪ Output presentation	▪ Validation of output. ▪ Discussion	▪ 2 day course ▪ 3 days approx
IEng - 3 **The ability to use the results of analysis to solve engineering problems, apply technology and implement engineering processes.**	▪ Look at existing data e.g. (borehole data) to design the base for a temporary structure /embankment.	▪ The design output and a summary report indicating their part in the production of the design.	▪ This will be based on the quality of design and the presentation.	▪ 5 days

Learning outcomes	Activity	Evidence	Assessment	Learning Time
IEng - 4 **The Knowledge, understanding and skills to define a problem, identify constraints and design a solution according to customer and user needs.**	▪ Brief interpretation ▪ Inspection and cataloguing ➢ Data requirements ➢ Define parameters ➢ Define ➢ criteria/standards ➢ Off-site relevant course ➢ Some analysis	▪ Presentation of written report and interpretation and application of standards.	▪ Based on the standard of the report and presentation, including Q&A discussion.	▪ Research 3 days ▪ Preparation of Report 1 day ▪ Preparation for and presentation of findings 1 day
IEng - 5 **The ability to use creativity and innovation in a practical context, ensure fitness for purpose (including operation, maintenance, reliability etc) and adapt designs to meet their new purposes or applications.**	▪ Appropriate element of a work-related project. For example, elements of temporary work construction: - ➢ Costs ➢ Wastage ➢ Disposal of waste ➢ Sustainability ➢ Pollution risk ➢ H&S risk ➢ Site visit	▪ To include, as appropriate: ▪ Identification of constraints ➢ Planning ➢ Design ➢ Operating/construction ➢ Specification met ➢ Costs ➢ Delays	▪ Drawings ▪ Short report – 1500 words including photographic evidence followed by a presentation and discussion	▪ 3 / 4 days ▪ 1 day of preparation

Learning outcomes	Activity	Evidence	Assessment	Learning Time
IEng – 6 **Knowledge and understanding of commercial and economic context of engineering processes.**	▪	▪	▪	▪
IEng – 7 **Knowledge of management techniques which may be used to achieve engineering objectives within the economic and commercial context of engineering processes.**	▪	▪	▪	▪
IEng – 8 **Understanding of the requirements for engineering activities to promote sustainable development.**	▪	▪	▪	▪

Learning outcomes	Activity	Evidence	Assessment	Learning Time
IEng – 9 **Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues.**	▪	▪	▪	▪
IEng - 10 **Understanding of the need for a high level of professional and ethical conduct in engineering**	▪	▪	▪	▪
IEng – 11 **Understanding of and ability to use relevant materials, equipment, tools, processes, or products;**	▪	▪	▪	▪

Learning Outcomes	Activity	Evidence	Assessment	Learning time
IEng – 12 **Ability to use and apply information from technical literature;**	▪	▪	▪	▪
IEng – 13 **Ability to use appropriate codes of practice and industry standards;**	▪	▪	▪	▪
IEng - 14 Understanding of the principles of managing engineering processes	▪	▪	▪	▪
IEng – 15 **Awareness of quality issues and their application to continuous improvement.**	▪	▪	▪	▪

Learning Outcomes	Activity	Evidence	Assessment	Learning time
IEng – 16 **Understanding of the need for a high level of professional and ethical conduct in engineering**	▪	▪	▪	▪