

Unit 5041: Engineering Project

Unit Code: M/650/2948

Level: 5

Credits: 15

Introduction

The work of the professional engineer very often consists of the specification, development, management and delivery of projects. It is essential that students following the path of becoming a professional engineer have a thorough grounding in all aspects of this important process.

This unit will guide the student through the design, testing and evaluation of a project within their specialist area. The processes of documenting, managing and presenting the outcomes of the project will form part of the work, as will the selection and use of commercially available management, simulation and presentation development tools.

Risk assessment, quality and cost issues, final analysis of outcomes, and the drawing of appropriate conclusions will also be covered. A final presentation will develop communication skills and include personal evaluation and reflection.

On successful completion of this unit, the student will have the skills and knowledge to initiate, manage, complete and evaluate complex engineering projects on-time and within budget.

Note to centre: This is essentially a practical unit with the completed project and all the attendant processes forming the assessed work; it is not expected that further work for assessment will be necessary. The Project Supervisor should guide students to ensure that the chosen project has enough scope to be sufficiently complex, such that the outcomes are at Level 5.

Learning Outcomes

By the end of this unit, a student will be able to:

- LO1 Propose an engineering-based project in line with national and international engineering regulatory and ethical frameworks
- LO2 Create an engineering-based project using project management software, tools and techniques
- LO3 Implement a project plan to include the production of a technical engineering report
- LO4 Present the engineering-based project and reflect on the project outcomes.

Essential Content

LO1 **Propose an engineering-based project in line with national and international engineering regulatory and ethical frameworks**

Selection of a suitable project:

Shortlisting of suitable projects based on considerations of cost, likely completion constraints and user needs

Identification of the nature of the problems under consideration through primary and secondary research methods, using digital and non-digital sources and relevant technical, engineering, industry, regulatory, legislative and ethical standards and risk factors

Feasibility study to identify constraints; scoping by defining objectives, purpose and deliverables; production of outline briefs; Feasibility study to identify constraints; scoping by defining objectives, purpose and deliverables; production of outline briefs; consideration of project related responsibilities at various levels including secure operations and application of appropriate processes, policies and legislation in the context of business goals, vision and values; tools/techniques for upgrading and maintaining systems within the project scope; resilience in undertaking project tasks and work securely within the business.

Health and safety policies, procedures and regulations, compliance, risk assessment processes and procedures.

Selection criteria and process:

Development of selection criteria (e.g. time constraints, risk evaluation, cost, skills set, availability of materials, meeting the user needs)

Selection and justification process – final selection.

Project aims:

Description of engineering-based project intentions and achievements, (e.g. design, test, construct, replicate, question existing)

Refinement of aims to clearly define the purpose of the engineering-based project

Development of specific aims that are clear, concise and provide a logical flow between each aim to establish an engineering-based project as a coherent whole.

Project objectives:

Goals or steps to achieve engineering-based project aims (e.g. specific, measurable, achievable, realistic, time-constrained (SMART)).

Difference between project aims and objectives:

Aims – describe what is hoped to be achieved

Objectives – detail how project aims are to be achieved.

Project proposal development:

Outline/summary of project (e.g. the problem the project intends to solve, the solution the project provides to the problem, the impact the project will have)

Project background (e.g. what is already known about the problem, primary and secondary research undertaken/literature review)

Project approach (e.g. project schedule (including important milestones), project team roles and responsibilities, risk mitigation, project deliverables, reporting tools)

Defining project deliverables (e.g. end product or final objective, project timeline, SMART goals that align with deliverables)

Resources (e.g. budget, cost breakdown, resource allocation plan)

Conclusion (e.g. summary of problem and solution, project impact).

LO2 Create an engineering-based project using project management software, tools and techniques

Project management software, tools, methodologies and techniques:

Review commercially available project management tools/software to select most suitable; consideration of requirements of the chosen project, difference between systems (e.g. Prince 2) and software (e.g. PMIS, Microsoft Project, PROMIST); task and tracking tools and techniques (e.g. Trello, Smartsheet, Excel); scheduling and time planning (Gantt chart or similar); network diagrams, types and applications; critical-path methods (PERT); budget management tools

Methodologies (e.g. waterfall, Agile, Scrum, Kanban, Scrumban, eXtreme programming (XP), Adaptive Project Framework (APF), Lean)

Project management techniques (e.g. SWOT, stakeholder matrices, risk mapping, radar chart and summary risk profiles).

Selection and application:

Justification of selection by criteria, level of detail and usability, flexibility considerations and constraints; pre-population of planning tools and updating regime; evaluation and summary of usability on project completion.

Production of project plan:

Production of final project plan with clear lifecycle considerations (e.g. initiation, planning, execution, closure, review and reflection), roles and responsibilities, timeline goals (using Gantt chart or similar), budget management (if applicable), project evaluation criteria (e.g. decision matrix, Health, Environment & Safety (HES) decision matrix, analytic hierarchy process (AHP), cost-effectiveness, organisation-based information architecture (OBIA), meeting the user needs)

Key performance indicators (KPIs)

Other project planning and management considerations: change management, compliance in delivering outputs, responsible planning and work prioritisation, focus on products/processes that are accessible, inclusive and diverse; predictive maintenance, route-cause analysis and effective problem solving, individual and team approaches to solving problems and risk management); commitment to upskilling/reskilling (e.g. digital competencies, sustainability), and continued professional development.

LO3 Implement the project plan to include the production of a technical engineering report

Project execution phase:

Conduct or simulate planned project activities to generate outcomes which provide a solution to the identified engineering problem

Review a range of practical examples to solve potential structural or performance-based issues using simulation software or experimental approaches

Continuous monitoring of project development against agreed project plan, adapting plan where necessary – specification and justification of changes

Effective use of work plan and time management using chosen packages; assessing effectiveness and useability of monitoring package(s); tracking costs and timescales for spending; modification of risk assessment as project progresses

Maintaining a project diary to monitor progress against milestones and timescales, including self-reflection on skills and personal development.

Project report:

Possible report formats, logical presentation of work, use of evaluation techniques, critique of data/findings/analysis, presentation of final outcome in terms of original project brief, explanation of cost/time overruns; avoidance of generalisations

Drafting and reviewing work; adherence to international, national, Engineering Council and ethical standards

Recommendations for further work, limitations of chosen process, possible areas for improvement; reflection on process, selected software/process effectiveness; personal reflection – strengths and areas for development to attain sustainable high-performance levels.

Termination of project:

Cost performance analysis, audit tails, comparison of project outcomes against planned objectives, qualitative and quantitative analysis of process and outcomes; close-out reports

Preparation of data and analysis for summary presentation

Process of self-reflection on project and personal performance.

LO4 Present the engineering-based project and reflection of the project outcomes.

Presentation:

Selection of presentation format, audience expectations and contributions, who to invite; what to include in presentation, logical presentation, avoiding 'busy' slides and assumptions, time allocation, summaries and project evaluation, handling question and answer (Q&A) sessions; inclusion of reflective practice.

Reflective practice:

Reflection on the activities and experiences (e.g. lessons learnt, teamwork, safety awareness, self-organisation, managing people, sustainability, technical expertise, communication skills, challenges, difficulties, strengths/weaknesses, own work practices, identification of areas to improve)

Tools (e.g. strengths/weaknesses/opportunities/threats (SWOT) analysis, 5R (reporting, responding, relating, reasoning & reconstructing) framework for reflection, Kolb's reflective cycle, Driscoll's model of reflection, Gibbs' reflective cycle, Schon).

Feedback:

Noting audience/third-party feedback and action plan to address issues; completion and closure of project reflective log; refining future professional practice and building further resilience within the project teams.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
L01 Propose an engineering-based project in line with national and international engineering regulatory and ethical frameworks		D1 Illustrate the effects of relevant current legislation, ethics and risk in developing an engineering-based project proposal.
P1 Propose an engineering-based project brief in line with national and international engineering regulatory and ethical frameworks P2 Develop engineering-based project proposal aims and objectives.	M1 Undertake a feasibility study to justify engineering-based project proposal.	
L02 Create an engineering-based project using project management software, tools and techniques		D2 Make full use of project management software to develop a comprehensive project plan with evaluation criteria.
P3 Create a project plan using project management software, tools and techniques.	M2 Make full use of project management software to develop a comprehensive project plan.	

Pass	Merit	Distinction
L03 Implement the project plan to include the production of a technical engineering report		D3 Critically analyse the project outcomes in the project report against the original project plan, making justified recommendations for further improvements.
P4 Implement required project activities, recording progress against original project plan. P5 Produce a coherent technical engineering project report covering each stage of the project. P6 Conduct or simulate planned project activities to generate outcomes which provide a solution to the identified engineering problem.	M3 Implement a full range of project activities, recording progress against original project plan. M4 Produce a structured and detailed technical engineering project report covering each stage of the project that includes justified project outcomes. M5 Review a range of practical examples to solve potential structural or performance-based issues using simulation software or experimental approaches.	
L04 Present the engineering-based project and reflection of the project outcomes.		D4 Critically evaluate the end-to-end delivery of the engineering-based project in terms of reflective practice and produce an action plan and recommendations for how third-party feedback might be addressed.
P7 Present the engineering-based project using appropriate media to a technically literate audience, and conduct a feedback session. P8 Reflect on project outcomes.	M6 Evaluate the end-to-end delivery of the engineering-based project in terms of own performance and how third-party feedback might be addressed.	

Recommended Resources

Note: See HN Global for guidance on additional resources.

Print Resources

Blokdyk G. (2022) *Engineering Project Manager Critical Questions Skills Assessment* (Paperback).

Desai A. (2022) *Engineering Project Management: A Quantitative Approach* (Paperback). Cognella, Inc.

Malheiro B. and Fuentes-Durá P. (Editors) (2022) *Analyzing the European Project Semester to Improve Engineering Education – e-Book Collection*. IGI Global.

Ma Y. and Rong Y. (2021) *Senior Design Projects in Mechanical Engineering: A Guidebook for Teaching and Learning* (Hardback). Springer Nature Switzerland AG.

Newton R. (2016) *Project Management Step by Step*. 2nd Ed. Pearson Education.

Siegel N.G. (2019) *Engineering Project Management*. Wiley.

Striebig B., Ogundipe A. and papadakis M. (2015) *Engineering Applications in Sustainable Design and Development* (S.I. Edition). Cengage Learning.

Oberlender G.D. (2014) *Project Management for Engineering and Construction*. 3rd Ed. McGraw-Hill Education.

Qiu M., Qiu H., and Zeng Y. (2022) *Research and Technical Writing for Science and Engineering*. CRC Press.

Thiel D.V. (2014) *Research Methods for Engineers*. Cambridge University Press.

Journals

Note: Example journals listed below provide a broad range of articles related to unit content and those relevant for the qualification. Staff and students are encouraged to explore these journals and any other suitable journals to support the development of academic study skills, and subject specific knowledge and skills as part of unit level delivery.

[American Journal of Engineering Research](#)

[Arabian Journal for Science & Engineering](#)

[Scientific Reports](#)

[Engineering Reports](#)

[Science Progress](#)

[Cell Reports Physical Science](#)

[Engineering Research Express](#)

[European Journal of Engineering and Technology Research](#)

[IETE journal of research](#)

[Indian Journal of Engineering](#)

[International Journal of Indian Research](#)

[International Journal of Engineering Research in Africa](#)

[International Journal of Engineering Research & Technology](#)

[International Journal of Project Management](#)

[Journal of Engineering in Industrial Research](#)

[Journal of Engineering Research](#)

[Journal of Engineering Research and Sciences \(JENRS\)](#)

[Journal of Engineering Research and Reports](#)

[London Journal of Engineering Research](#)

[The Journal of Engineering Research \[TJER\]](#)

Links

This unit links to the following related units:

Unit 4004: Managing a Professional Engineering Project

Unit 4031: Introduction to Professional Engineering Management

Unit 4062: Professional Engineering Practice

Unit 5001: Research Project

Unit 5002: Professional Engineering Management.