Pearson BTEC Level 4 Higher Nationals in Engineering (RQF)

# Unit 4:

# Managing a Professional Engineering Project

# Unit Workbook 1

in a series of 2 for this unit

Learning Outcome 1

# Formulating & Planning a Project

# Contents

# INTRODUCTION

**Formulate and plan a project that will provide a solution to an identified engineering problem.**

- *Examples of realistic engineering-based problems:*
  - Crucial considerations for the project.
  - How to identify the nature of the problem through vigorous research.
  - Feasibility study to identify constraints and produce an outline specification.
- *Develop an outline project brief and design specification:*
  - Knowledge theories, calculations and other relevant information that can support the development of a potential solution.
- *Ethical frameworks:*
  - The Engineering Council and Royal Academy of Engineering's Statement of Ethical Principles.
  - The National Society for Professional Engineers' Code of Ethics.
- *Regulatory bodies:*
  - Global, European and national influences on engineering and the role of the engineer, in particular: The Royal Academy of Engineering and the UK Engineering Council.
  - The role and responsibilities of the UK Engineering Council and the Professional Engineering Institutions (PEIs).
  - The content of the UK Standard for Professional Engineering Competence (UKSPEC).
  - Chartered Engineer, Incorporated Engineer and Engineering Technician.
- *International regulatory regimes and agreements associated with professional engineering:*
  - European Federation of International Engineering Institutions.
  - European Engineer (Eur Eng.)
  - European Network for Accreditation of Engineering Education.
  - European Society for Engineering Education.
  - Washington Accord.
  - Dublin Accord.
  - Sydney Accord.
  - International Engineers Alliance.
  - Asia Pacific Economic Cooperation (APEC) Engineers Agreement.

# GUIDANCE

This document is prepared to break the unit material down into bite size chunks. You will see the learning outcomes above treated in their own sections. Therein you will encounter the following structures;

**Purpose** — Explains *why* you need to study the current section of material. Quite often learners are put off by material which does not initially seem to be relevant to a topic or profession. Once you understand the importance of new learning or theory you will embrace the concepts more readily.

**Theory** — Conveys new material to you in a straightforward fashion. To support the treatments in this section you are strongly advised to follow the given hyperlinks, which may be useful documents or applications on the web.

**Example** — The examples/worked examples are presented in a knowledge-building order. Make sure you follow them all through. If you are feeling confident then you might like to treat an example as a question, in which case cover it up and have a go yourself. Many of the examples given resemble assignment questions which will come your way, so follow them through diligently.

**Question** — Questions should not be avoided if you are determined to learn. Please do take the time to tackle each of the given questions, in the order in which they are presented. The order is important, as further knowledge and confidence is built upon previous knowledge and confidence. As an Online Learner it is important that the answers to questions are immediately available to you. Contact your Unit Tutor if you need help.

**Challenge** — You can really cement your new knowledge by undertaking the challenges. A challenge could be to download software and perform an exercise. An alternative challenge might involve a practical activity or other form of research.

**Video** — Videos on the web can be very useful supplements to your distance learning efforts. Wherever an online video(s) will help you then it will be hyperlinked at the appropriate point.

There are countless examples of engineering problems encountered in daily life, we can see how these problems have been solved and how there are still some solutions to be found. Any manufactured product you can think of, is a solution to an engineering problem. A classic example is the coffee cup sleeve, this was developed in the early 1990s as a response to takeaway coffee being served in cups which were very hot when held. Therefore, people often burned their hands, or even dropped the coffee and possibly burned their lap, not to mention wasted the coffee by spilling it. The need here was to drink hot takeaway coffee, however the problem was that the coffee cup was too hot to hold, various solutions were thought up. A simple solution was to ‘double cup’, which involved simply placing the filled cup inside an empty cup to provide insulation, whilst this was relatively effective, it was also incredibly wasteful. Therefore, the problem was refined so that the solution should not be this wasteful. Initial ideas involved a fully insulated cup, however, it transpired that not all coffee drinks actually required insulation, for example a latte or an iced coffee. Previous attempts at a fully insulated cup had also been attempted, see below:

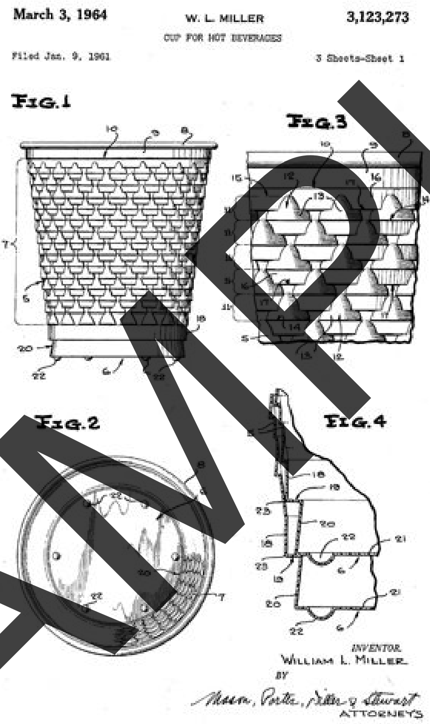


*__Figure 1.5:__ Fully Insulated Coffee Cup Idea*

Eventually, the sleeve was developed as an efficient and cost-effective solution that could be used only when it was required and was not wasteful.

**Challenge**

Think about an everyday object that you use, what was the need for this object and what problems had to be solved in creating it? What were the likely refinements?

these requirements are all subjective, so how can we quantify them? There are some tools for translating these user requirements into a specification, one could use a quality function deployment (QFD) tool, for example, the Kano model or a functional dependence table. It may not always be necessary to use formal tools to translate the requirements into a quantitative specification.

There are many examples and templates of project specifications available online, and most of them will not be suitable for your own project, some may be far too over-complicated, and others may well be too simple. This can be very off-putting to any budding project manager, which may lead to skipping the specification step, this will usually only result in a poor-quality output, delays and expenses. Often, there are industry specific specification regulations or templates which must be used, examples may include those for architecture, websites and documents. For the purposes of the unit, we can assume that a relatively simple engineering specification will be suitable, depending on each application, the specification will be slightly different.

For example, a typical simple product design specification may resemble the following format:

**Performance**

- At what speed must it operate?
- How often will it be used (continuous or discontinuous use)?
- How long must it last?

**Environment (during manufacture, storage and use)**

- All aspects of the product's likely environment should be considered: for example, temperature, humidity, risk of corrosion, vibration.

**Target product cost**

- This is strongly affected by the intended market.

**Competition**

- What is the nature and extent of existing or likely competition?
- Does our specification differ from the competition?
- If so, why?

**Quantity and manufacture**

- Should it be made in bulk, in batches, or as individual items made to order?
- Does it have to be a particular shape?
- Can we make all the parts, or must we buy some in?

**Materials**

- Are special materials needed?
- Do we have experience of working with the likely candidate materials?

**Quality and consistency**

# 1.2 Frameworks & Regulations

Any professional engineer carries great responsibility in their work, any output of theirs may be used by other people, be they colleagues or members of the public. It is therefore essential that engineers follow established guidelines to make good decisions, act properly and to keep end users safe. Over time, professional engineering establishments and bodies have developed codes of conduct and regulations to govern the behaviour and expected standards of engineers in the workplace.

## 1.2.1 Ethical Frameworks

Several organisations have published ethical frameworks for engineers to follow, one particular example is the Statement of Ethical Principles from the Royal Academy of Engineering & the Engineering Council. The statement is based on the following four principles: Honesty & Integrity, Respect for Life, Law, Environment & Public Good, Accuracy & Rigour and Leadership & Communication. Another example is the Code of Ethics from the National Society for Professional Engineers, this code is based on five fundamental canons, five rules of practice and nine professional obligations. Both the Statement of Ethics and the Code of Ethics can be found in the resources section for this unit on Moodle and the following links will take you to their official websites:

https://www.engc.org.uk/standards-guidance/guidance/statement-of-ethical-principles/

https://www.nspe.org/resources/ethics/code-ethics

When working in engineering on any kind of project, we should all follow these statements and codes.

## 1.2.2 Regulations

Aside from the frameworks which suggest behaviour, there are more specific regulations which define certain actions, an example of one of the regulatory bodies is the Royal Academy of Engineering, which states its role is to advance and promote excellence in engineering for the benefit of society, with three strategic priorities: make the UK the leading nation for engineering, innovation & business, address the engineering skills crisis and position engineering at the heart of society. Another regulatory body is the UK Engineering Council, which holds the national register of professional engineers, including engineering technicians, incorporated engineers, chartered engineers and information and communications technology technicians. Professional engineers who are registered with the council have been assessed in terms of their competence and commitment by their peers, whilst the Engineering Council also sets and maintains internationally recognised standards of professional competence and ethics that govern the award of these titles.

Depending on the job role, there are several different titles which may be awarded. The benefits that come with these titles include improved career prospects and employability, higher earning potential, demonstration of professional attitude, enhanced status, international recognition, evidence of expertise and greater influence.

Additionally, there is a document known as the UK Standard for Professional Engineering Competence (UKSPEC) which sets out the competence and commitment required for registration as one of these titles and includes examples of activities that demonstrate the requirements. There are five areas of competence and commitment, as follows: Knowledge & Understanding, Design and Development of Processes, Systems