Pearson BTEC Levels 5 Higher Nationals in Engineering (RQF)

Unit 34: Research Project

Unit Workbook 1

in a series of 1 for this unit

Learning Outcome 1

Research Project

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Contents

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INTRODUCTION

This Workbook guides you through the learning outcomes related to:

- Conducting the preliminary stages involved in the creation of an engineering research project.
- Examining the analytical techniques used to work on all stages of the project and strategies required to overcome the challenges involved in a research project.
- Reflecting on the impact the research experience could have in enhancing personal or group performance within an engineering context.
- Exploring the communication approach used for the preparation and presentation of the research project's outcomes

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.

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Planning and conducting a small research project

This Workbook addresses the task of planning and conducting a small research project. It aims to help you develop a clear sense of direction early on in the project, and to support you in organising, planning, and monitoring your project.

What it will do is point you in the right direction, enabling you to gather information and techniques in undertaking a research project. What it won't do is give you all the information on a plate. In order to answer the assignment questions fully you will need to undertake substantial investigative work of your own.

1. What is a research?

Research is a particular kind of academic task. You will usually be asked to generate a topic for yourself; to plan and execute a project investigating that topic; and to write-up what you did and what your findings were. Important stages in the process include:

- choosing a topic;
- developing a research question;
- effective planning of the research;
- being organised and methodical while conducting your research; and
- reporting the research.

2. Research Philosophy in Engineering and Technology Management

The purpose of research is to generate new knowledge, thereby enabling the development of new products, processes and services, to better understand and interact with our environment, thereby improving the quality of life in our communities and the sustainable management of ecosystems.

The purpose of research in project management, engineering management and technology management is to generate the knowledge and practical techniques which can be used to improve the management of technological innovation, the implementation of new projects, the sustainability of technology-based organisations, and the outputs of national systems of innovation. Engineering and technology management links the engineering, science, and management disciplines; it provides the interface between technology and other corporate functions such as research and development (R&D), marketing, manufacturing and administration.

Technology management also addresses the issues involved in the planning, development, and implementation of technological capabilities which shape and accomplish the strategic and operational objectives of an organisation. It covers not only R&D management, but also the entire spectrum of managerial concerns in technology-based organisations, including issues relating to human resource management, innovation process management, project management, marketing, forecasting, technology roadmaps and strategic planning.

Research in relation to Engineering and Technology Management tends to be focussed on the improvement and further development of the theory, science and practice of engineering and technology

management, producing material of relevance to both academics and practising managers. It should be conducted according to the guiding principles of academic rigour and scholarship.

Within the various areas of science and in compliance with the broad principles of scientific research, a wide range of research methodologies have historically been developed and applied, including quantitative, mixed and qualitative approaches. Most of these can be, and indeed have been, used within the field of engineering and technology management. However, the latter field is typically an applied science, dealing with the highly practical problems of managing technology-based organisations in a competitive global market. As a result, there is a preference for certain types of research designs; for example, there is a bias towards applied or empirical research versus basic, philosophical or highly theoretical studies.

Considering that management is predominantly a behavioural science, there is also a preference for the approaches used in the social sciences rather than in the natural sciences. The dominant research designs in the natural sciences are laboratory and field experiments. These designs are less appropriate in engineering and technology management as it is difficult to obtain the highly controlled conditions required for this type of research.

A common misconception amongst engineering and technology management students is that doing research is synonymous with doing a "management investigation". This is not the case; a management investigation consists of the application of acquired knowledge to a specific management problem in an organisation, whereas research is the generation of new knowledge which can be generalised to other environments. The investigator's subjectivity is acceptable when performing a management investigation, but research requires scientific objectivity. Insight and sound judgement are expected of a good management investigation, but research requires empirical proof. The outcome of a management investigation is mostly a company-confidential management report, whereas research can be published in academic peer-reviewed journals. This is illustrated in Table 1.

Aspect	Academic Research	Management Study
External validity	The results can be applied more widely than the unit of research (company or individuals)	The results are only valid to the specific company or individual
Theory	Builds new theory or tests existing theory	Applies theory but at a simplistic level
Source of background knowledge	Mostly recent peer-reviewed literature	Mostly trade articles and other management studies
Teleological	Seeks causative relationship	Focussed on improvements and results
Methodology	Seeks novelty (insights)	Replication of proven formulae for success

Table 1 Academic Research and Management Study

Engineering and technology management science aims at understanding the processes involved in the management of technology-based organisations. The desired research output is both new theory and novel practical techniques that can be applied by managers in their day-to-day management activities. The theories can be embodied in conceptual models (graphical, mathematical or schematic descriptions or analogies) or practical methods (procedures or techniques), and supported by observations and investigations of actual practice. As already stated, this implies an empirical approach, based on practical methods and observations supported by a sound theoretical basis (known as theory-based empirical research). A research project should therefore contain elements of concrete experience, reflective observation, abstract notions and active experimentation as depicted in the research–application cycle. The types of research designs that are preferred are therefore theory, model or method-building, testing, and application empirical research. This is illustrated in Figure 1.
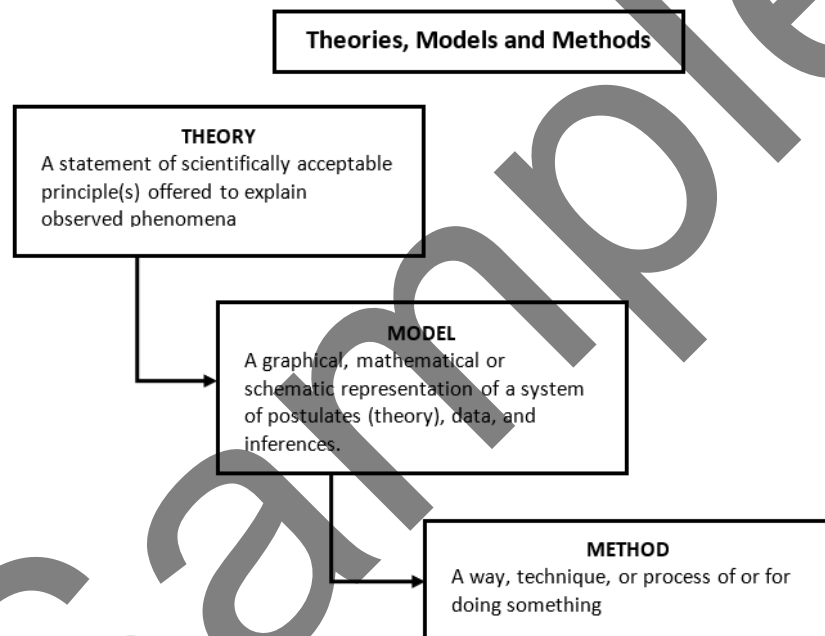

Theories, Models and Methods

THEORY
A statement of scientifically acceptable principle(s) offered to explain observed phenomena

MODEL
A graphical, mathematical or schematic representation of a system of postulates (theory), data, and inferences.

METHOD
A way, technique, or process of or for doing something

Figure 1 Theories, Models and Methods

Studies must develop, test, or advance management theory and practice and should have well-articulated and strong theoretical foundations. All types of empirical methods, be they quantitative, qualitative, or combinations, are acceptable. Case studies and well-considered observations of management experience, survey research, methodological studies, replications and extensions of past research are acceptable providing the work provides new conceptual or theoretical insights.

The application of existing theories, models and methods to routine management problems is management practice and cannot be considered as research. Although the ability to apply acquired knowledge and skills is an important outcome of the education process for managers, and it is required of management students to demonstrate this ability, such project assignments will result in "Management Reports" and cannot qualify as a research project, for which there must also be some generation of new knowledge. In this regard, the application of existing theories, models and methods to a "new" problem or

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