
Developing Professional Skills in a Distance-Taught MEng Degree in Preparing for Engineering Institutions' Professional Review and for CPD

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The persistent demands from employers for engineering graduates with professional as well as technical skills, coupled with the new academic demands in SARTOR'97 and the recommendations of the Dearing Report, have led to increased demand for an engineering degree qualification which more fully prepares participants for professional life. The Open University has addressed this problem with the development of a Master of Engineering degree which couples the teaching of high level technical skills through an individual negotiated programme of distance-taught study, with the development of reflective, key and life-long-learning skills. Compulsory courses at the beginning and end of the 480 point degree focus on the development of process skills to aid professionalism; in the first course within the context of planning an individual degree programme and career path; the second compulsory course aims to develop process skills in preparing for CPD and the UK Engineering Institutions' Professional Review, a compulsory step in becoming a Chartered Engineer. This paper describes the degree programme and how the documentation and procedures needed to complete the Professional Review and plan for CPD are introduced to the student and used as a focus for the development of professional skills.

THE EMPLOYERS' PERSPECTIVE: A GROWING CURRICULUM

In the 1970s, disquiet within the engineering industry and government about the effectiveness of engineering education to produce graduates who were able to function and develop successfully throughout their careers began to emerge. This disquiet led to the setting up of a commission of enquiry into the engineering profession chaired by Sir Monty Finniston. The Report of this enquiry made recommendations about the education and training (the *formation*) of young engineers [1]. These recommendations related to both the academic content and approach of courses and to the professional development before and after admission to membership of a professional institution.

One outcome of the Finniston Report was the setting up and empowerment of the Engineering Council based on an earlier group (the Council of Engineering

Institutions, CEI). These bodies were charged with certain responsibilities for the engineering profession and act to formalise dialogue between all the engineering institutions incorporated by Royal Charter. These responsibilities included the regulation of standards, including educational standards. The collaboration of member institutions led to agreement and confirmation on *standards and routes to recognition* (SARTOR) and the publication in 1985 of the first version. This document defined the criteria for full membership and Chartered Engineer status, including the minimum academic qualification required as a Bachelors degree with Honours in an appropriate subject. The professional development required, post qualification, was also clearly defined.

It was recognised before 1960 that knowledge and understanding of commercial practice was desirable for most Chartered Engineers engaged in business. A formal requirement for passes in courses on Industrial Administration was defined in the early 1960s.

Later it was recognised that engineers also needed to understand the social relevance and accountability of their professional practice and a paper entitled *The Engineer in Society* was made mandatory in institutions' entrance examinations.

The most recent SARTOR document describes a new system of steps towards recognition for Chartered and Incorporated Engineers [2]. These steps embrace the concept of competence building and assessment alongside the development of specialist knowledge and a commitment to life-long learning through professional development. The complexity of the requirements in SARTOR'97 reflects the ever growing complexity and range of engineering theory and practice.

The new minimum requirement for full membership and chartered status in engineering is a four year accredited MEng degree. The need for social awareness, professional ethics and a knowledge of business practice remain and subjects to teach them are normally integrated into the core curriculum. One condition for accreditation within the new regulations is that 80% of the intake must gain 24 points at A level standard. Open University students gain entry to the institutions through the Individual Case procedure, (OU degrees can never become accredited because of the open entry policy which is a feature of Open University study). All institutions offer an Individual Case route to membership for candidates who do not meet the standard educational or other criteria.

Further demands from engineering employers, the Engineering Council and engineers themselves mean that future professional engineers must be equipped to manage career changes, advances in technology and their own Continuing Professional Development (CPD) throughout their working life [3-5]. They must be equipped to work well with others and, most importantly, be able to communicate effectively in the written and spoken word and in presentations. These *key skills* are also now being integrated into the mainstream engineering curriculum and assessed as part of the education process.

The Dearing Report, published in July 1997, advises on the long term development of higher education (HE) in the UK and contains recommendations on how the purposes, shape, structure and funding of HE should develop in the next twenty years [6].

In general within the Report there is a stress on working towards delivering, assessing and accrediting better teaching practice, with a greater emphasis on *new approaches to learning and teaching*. Stress is placed on the need for the integration

of the process skills (or key skills) of communication, working with others and managing own life-time learning and development into the core curriculum.

THE CHARTERED ENGINEER

All engineers are responsible for safety, fulfilment of legal and contractual obligations, and ethical and environmental impact of their work. Chartered engineers undertake work that needs original thought and judgement. They are concerned with technological progress through innovation, creativity and change.

The competence of Chartered Engineers is based on their *initial formation* (educational base and IPD), their *continued development* throughout their working lives (CPD) and the expertise they develop as their career progresses and they undertake various projects and responsibilities.

THE UK AND ENGINEERING EDUCATION

Many engineering courses offered in the UK are heavily traditional in the view they give of engineering, focusing as they do on the definition and isolation of problems and the search for technical solutions. Such things as the criteria for accreditation and the attitudes of professionals both in industry and academic institutions encourage this view of the subject. Exposure to this culture throughout educational formation can often result in graduate engineers who both lack and do not appreciate the value or relevance of the skills of reflection, communication and working with others so prized by engineering employers. Early in their career undergraduates can *receive* a model of the engineering professional and a specific type of world view. This view is effective for solving narrowly defined technical problems but falters when the ambiguity and complex processes of self-development are involved. The engineering profession now realises that it can no longer afford to embrace such a narrow view of knowledge and problem-solving.

The content and approach of courses and the intellectual processes developed within the student need to be re-evaluated to take account of the need to live and work in a rapidly evolving professional world. The attitudes of engineers to *softer* issues of people, ideas, reflection need to be addressed at a fundamental level.

Thus for tomorrow's Chartered Engineers, academic development does not only involve the acquisition of bodies of technical knowledge and the

experience to apply it. It means developing an ethical sense and an awareness of their social responsibility for the work of engineers, a knowledge of business practice, an understanding of key skills and the development of the process skills to function effectively in society and the workplace and to manage their own life-long learning and career development.

Within higher education a number of programmes are contributing towards changes in the curriculum aimed at giving students a sound mathematical and technical educational base, but also enabling them to become more effective life-long learners, better able to contribute to society and the world of work.

These programmes have aimed to develop students' personal transferable skills beyond the educational arena, enabling individuals to act effectively on their environment, particularly in the world of work. A key component of these personal skills is students' ability to manage their own learning and development.

A number of universities are now including components in *personal and career development* as accredited parts of their degrees [7-12]. These courses focus directly on the teaching and assessment of general skills and capabilities valued by universities and employers, for instance self-awareness, context awareness, decision making, action planning, research, analysis, communication skills and critical reflection.

ANew OPTION: A DISTANCE-TAUGHT MEng DEGREE

The Open University has since its inception in 1970 offered distance taught, part-time degree level study in a range of subjects to students who are able to work and study simultaneously. Students are able to register with the University without prior qualifications, choose their own degree programme and study course modules over a number of years. Courses run from February to October, assessment is normally performed by a weighted mix of tutor marked assignments and end of course exam. Students can choose to study any number of modules per year; these are normally worth 30 or 60 points each although two 60 point modules per year is normally considered to be an absolute maximum workload. Students are able to choose technology subjects to build a degree, which can lead to full professional status as a member of an accredited engineering institution.

Dialogue with selected engineering institutions has been going on for some years in an effort to

agree Open University course profiles acceptable to them so that OU students can apply for membership and Chartered Engineer status on an individual case basis. Many candidates have successfully used this route to Chartered Engineer status. These profiles are published by the University and help define course choice for interested students [13].

The new Master of Engineering degree programme, offered from February 1998, is designed to fit in with SARTOR'97, which proposed a new, more rigorous system of steps towards recognition for Chartered and Incorporated Engineers. This embraces the concepts of competence building and assessment alongside the development of specialist knowledge and a commitment to life-long learning through professional development. The MEng degree aims directly to meet professional development needs as endorsed by the Engineering Council and relevant professional bodies. The development of this programme has been guided by a Steering Group which includes representatives from the Engineering Council, the Engineering Employers Federation and the Institutions of Mechanical and Electrical Engineers.

The MEng degree is planned as a framework within which students are helped to analyse their starting point on a route to professional recognition and then to identify their educational and professional development needs. The programme of courses required to fulfil the MEng award regulations and to satisfy the academic requirements of their chosen institution would be agreed by the candidate, the University and their chosen engineering institution during the first year's study on T191, *Personal and career development in Engineering*. The student will be assisted in their task of selecting an appropriate programme of courses by their personal Tutor and by established agreements between the University and some of the engineering institutions [13]. The chosen programme of courses would then be undertaken by the candidate during the degree course. In T191 the student is required to operate a process of *Assess-Plan-Act-Review* (see Figures 1 and 2) in the context of their own personal and career development. Through the operation of this process it is anticipated that students will practice and develop life-long learning and the key skills of communication and personal management. The course contains material on working with others to raise awareness and give practice of this crucial professional skill. The objectives, strategy and assessment of this course has been fully described before [14][15].

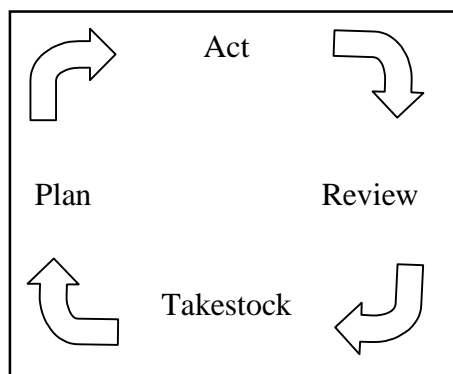


Figure 1: Four stage process.

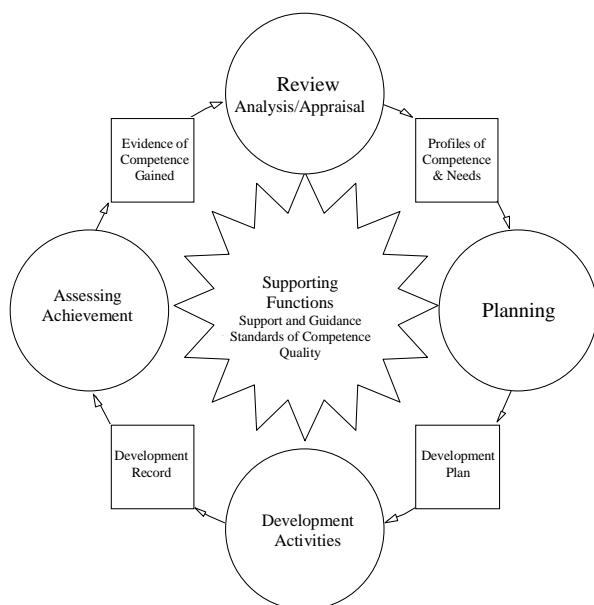


Figure 2: Expanded version of process, advocated by the Engineering Council.

The MEng programme is offered as a *sandwich* with the two compulsory 15 credit point courses, T191, *Personal and career development in Engineering*, as a first course and T397, *Key skills for Professional Engineering*, as the final course for the degree. It is in these two compulsory courses that the teaching and assessment of *professional* skills are delivered.

Award requirements for the MEng degree are:

- A minimum of 480 credit points.
- A minimum of 255 points from taught courses at levels 3 or 4 or, in the future, Master's programmes, including a 60 credit point major individual project.
- Passes in T191 and T397, *Key skills for Professional Engineering*.
- The majority of courses to have an *engineering content*.
- A maximum of 120 points of level 1 study.

T397, KEY SKILLS FOR PROFESSIONAL ENGINEERING

In T397, *Key skills for Professional Engineering*, the student will revisit the four stage process of *Assess-Plan-Act-Review*, but this time in the context of preparing for the Institutions' Professional Review and for CPD. This course is designed to develop further, and to give practice in, key and reflective skills and to introduce and use the official documentation they will encounter in moving towards Chartered Engineer status.

THE PROFESSIONAL REVIEW

The Profession Review (PR) demanded by the Engineering Institutions from applicants for Chartered Engineer status is the culmination of an Engineer's initial formation. It is the final stage of assessment of competence and commitment prior to registration. It is the focus of the work to be undertaken on T397 and the process by which the final judgement is made for institution membership and registration.

The PR will normally include a written report and an interview by two appropriate Chartered Engineers. Sometimes the panel will also include a member nominated by the Engineering Council.

The Report should show such things as the educational record and attainment of the required standards, IPD with supporting evidence, areas of accountability for the exercise of engineering and technical judgement as exemplified by the identification, analysis and solution of engineering problems appropriate for a Chartered engineer.

The material in the Report should substantiate the understanding of the technical, financial, social and environmental implications of decisions taken. It should cover the efforts made to keep up-to-date in technology and in Institution activities, and include a Development Action Plan.

The PR will include examination of plans for and commitment to CPD. CPD is defined as *the systematic maintenance, improvement and broadening of knowledge and skills and the development of personal qualities necessary for the execution of professional duties throughout working life*. The process comprises:

- Maintaining up-to-date professional competence so that practice is fully in line with current requirements.
- Updating particular areas of competence.
- Development of personal and management skills.
- Broadening of experience leading to new opportunities.

- Working within a mature understanding of professional codes.

Individuals are expected to take responsibility for their own career development. It should be guided by a development plan and recorded in a professional development record. When a candidate is considered for PR, s/he is required to show how they intend to meet their CPD obligations. Membership of a professional institution and professional registration requires individuals to maintain and develop their professional competence.

A multi-institution working group has recently produced a generic version of a Professional Review proforma to provide guidance and consistency in each institution's approach to the Professional Review. This document is an integral part of T397 and provides students with authentic material to work with.

PREPARING FOR THE PROFESSIONAL REVIEW

The competence and commitment criteria to be satisfied at the Professional Review are shown below and are described in considerable detail in the formal document. Extensive use of occupational standards are made throughout the document.

Competence aspects

Competence is partly covered by A-D (Table 1) and includes:

- The broad knowledge, understanding, experience and skills appropriate to the level of registration.
- A detailed understanding of the principles and mastery of the knowledge and analytical skills required for a specialist engineering role.
- The ability to perform the technical role fully and well.
- The supervisory, management and personal skills that are required in order to be effective in both expected and unforeseen situations.

The most straightforward way to achieve parts of

this leads to the attainment of competence by an accredited academic course at the appropriate level and an accredited programme of initial professional development.

Experience as a practising engineer is also needed to satisfy fully the competence and commitment requirements.

Commitment aspects

Commitment is largely covered by aspect E in Table 1 and will be assessed at PR. Engineers seeking admission to the Register should demonstrate commitment to:

- the maintenance of competence to practice in their chosen area of work as roles, technology and employment structures change;
- participation in the broader profession, industry and society, particularly through the support of new or prospective entrants to the profession;
- the application of the Code and Rules of conduct to their own work, including the Codes of Practice relating to risk and environmental issues and the Continuing Professional Development Code.

USING THE PROFESSIONAL REVIEW IN T397

T397 is an activity-based course using the process of *Assess-Plan-Act-Review* and the formal documentation for the PR and for CPD. Its objectives are to:

- introduce candidates to the process of Professional Review, which is the procedure that examines competence as a professional engineer and is the assessment process for becoming a Chartered Engineer;
- provide practice in presenting for the Professional Review;
- look at the competencies and commitment criteria that define a professional engineer;
- provide practice in producing evidence for assessment against the criteria;

Table 1.

A	Use a combination of general and specialist engineering knowledge and understanding to optimise the application of existing and emerging technologies
B	Apply appropriate theoretical and practical methods to the analysis and solution of engineering problems
C	Provide technical, commercial and managerial leadership
D	Use effective communication and interpersonal skills
E	Make a personal commitment to live by the appropriate code of professional conduct, recognising obligations to society, the profession and the environment

- set in place a structure for CPD;
- plan for the future with a new development plan.

The course assessment for T397 will be based on a portfolio, which will consist of two parts:

- 31 Completed course Activity Sheets
- A Summary Narrative

The activity sheets have been planned to lead the students through the four-stage process (A-P-A-R) in completing a draft professional review. The Summary Narrative is intended to give practice in the skills needed to write a Professional Review Report and will demonstrate the student's ability to argue a case, to evaluate and make decisions and recommendations based on evidence. It is the final part to be completed, although a start should be made early in the course. Its main function is to justify and explain the work presented and how it leads to the final conclusions and action plan.

The Summary Narrative is a document in which the student assesses their current situation in relation to the formation requirements and competence and commitment criteria, discusses the *gaps* and looks to the future to plan how these gaps will be filled. The final conclusion will indicate which of the three outcomes mentioned below is appropriate in each case. The Summary Narrative should finish with a Development Plan, which flows logically from the arguments within it.

The students will be led to one of three possible outcomes:

- You currently meet the criteria to be accredited as a Professional Engineer, with the exception of the educational requirements, which will be met once you have completed your Open University MEng course.
- You expect that you will meet the criteria to be accredited as a Professional Engineer by the time you have completed your Open University MEng course (an Action Plan should be provided to show what development is still required).
- You do not expect that you will meet the criteria to be accredited as a Professional Engineer until some time after you have completed your Open University MEng course (an Action Plan should be provided to show what development will be required and an estimate of when you expect to meet the criteria).

The Action Plan should include what needs to be done to reach the point of Professional Review and a target date for that submission. Some guidelines for *structuring* and *writing* this type of document are given in T397.

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BIOGRAPHY

Tony Pearce has been a university lecturer and researcher for 25 years and is currently the Director of the Open University's Master of Engineering Degree programme. In this role he has strong links with a number of national bodies in the engineering sector, including the Engineering

Council, the Engineering Employers Federation, the Institutions of Mechanical and Electrical Engineers, OSCEng and CISC. For the past 11 years he has also directed a management and IT consultancy and training organisation, from 1987-1991 within the Open University and since 1991 independently as Network Consultants.

At the Open University, Tony has gained experi-

ence and skills in designing, developing and promoting multimedia distance-learning programmes and managing the work of course teams and external consultants. He has made contributions to initiatives, including the professional development of engineers, life-long learning, key skill development, implementing the recent Dearing Report, the development of high level engineering VQs and the use of competence-based assessment for initial and continuing professional development.

Outside the Open University, Tony's work involves the identification and marketing of training and development products which are attractive to businesses wishing to improve their competitiveness in the areas of general and technical management. In both the above roles he has been motivated by the objectives of equipping individuals and organisations with relevant technical and managerial skills which reflect the latest developments in IT and team-building strategies, thus making them more able to survive, progress and prosper in the competitive commercial world.

Global Congress on Engineering Education: Congress Proceedings

edited by Zenon J. Pudlowski

These Congress Proceedings contain papers submitted for the first *Global Congress on Engineering Education*, held at the University of Mining and Metallurgy (Akademia Górniczo-Hutnicza), Cracow, Poland, between 6 and 11 September 1998. The Congress incorporated three on-going, major and extremely successful international meetings: the *5th World Conference on Engineering Education*, the *4th East-West Congress on Engineering Education* and the *1998 International Congress of Engineering Deans and Industry Leaders*.

Close to 140 papers included in the Congress Proceedings present and discuss research and developmental activities in engineering education carried out throughout the world. Particular emphasis has been placed on globalisation of engineering education to stress the importance and relevance of collaboration between universities worldwide. Of particular interest and value are the many papers from authors in developing countries and countries in political, economic and social transition. Some of these papers present considerable achievements made over the last few years, while others demonstrate that some of these countries still grapple with fundamental changes to be made to their systems of engineering education.

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