
The Formation of an Engineer: the British Method of creating Engineers

George Page

Liverpool John Moores University, Byrom Street, Liverpool, L3 3AF, England, United Kingdom

The training of engineers in the UK is controlled by the Engineering Council in collaboration with the engineering institutions. The whole process is governed according to an agreed set of rules embodied in the SARTOR document. This paper outlines the general principles embodied in SARTOR and the ways in which the universities and engineering institutions implement them.

INTRODUCTION

The education and training of engineers in the United Kingdom has been controlled by the Engineering Council and its predecessors since the 1950s. This is the overseeing body which decides the overall rules and deals with the final registration of engineers. However it leaves the detailed administering of the system in the individual subject areas to various nominated bodies (the Engineering Institutions). The nominated bodies are inspected by the Engineering Council at regular intervals of no more than five years and usually less. If their standards and procedures are considered satisfactory then they are licensed to nominate candidates for inclusion in one of the sections of the Engineering Council Register. The list of nominated bodies who are licensed to nominate Chartered Engineers is given in Table 1. Each nominated body has voting rights in the Engineering Council and each provides representatives to the various working groups within it.

The document in which the rules and regulations for the training and educational requirements of the various grades of engineer are laid down is known as SARTOR (Standards And Routes TOWards Registration). The UK is just starting the implementation of the third edition of this document. It is the bible which university departments and industrial training managers have to obey when devising any courses of education and training for which they are intending to seek Engineering Council recognition (accreditation).

THE DIFFERENT LEVELS OF ENGINEERING REGISTRATION

Three levels of accredited engineer are recognised

by the Engineering Council:

- The Chartered Engineer CEng
- The Incorporated Engineer IEng
- The Engineering Technician EngTech

At the top are the Chartered Engineers who would be expected to be involved in design, research or the commissioning of major systems. They would occupy positions in middle or senior management and would normally have a university honours degree or higher.

The Incorporated Engineer has a different training from the Chartered Engineer and would be responsible for the day-to-day running of an industrial plant or the design and commissioning of systems. They could occupy key positions in operational management and would usually have a university degree or a Higher National Diploma.

The requirements for an accredited Engineering Technician are more concerned with practical training and experience rather than advanced qualifications. They would be expected to have an Ordinary National Diploma, or equivalent, and to have considerable experience at an appropriate level. They might work as technicians, foremen or supervisors.

The Chartered Engineer

The requirements for the training of Chartered Engineers under SARTOR 2, which applied up to two years ago, are explained in this section and then the modifications due in the latest version of SARTOR, SARTOR 3, are presented. It is still relevant to consider the requirements of SARTOR 2 because many engineers will be applying for registration under the old rules for

Table 1: Bodies licensed to nominate Chartered Engineers.

	Register Section		
	Chartered Engineer	Incorporated Engineer	Technician Engineer
Royal Aeronautical Society	✓	✓	✓
Chartered Institute of Building Service Engineers	✓	✓	✓
Institution of Chemical Engineers	✓	✓	
Institution of Civil Engineers	✓	✓	✓
British Computer Society	✓	✓	
Association of Cost Engineers	✓		
Institution of Electrical Engineers	✓		
Institute of Energy	✓	✓	
Institution of Gas Engineers	✓	✓	✓
Institute of Marine Engineers	✓	✓	✓
Institute of Materials	✓	✓	✓
Institute of Measurement and Control	✓	✓	✓
Institution of Mechanical Engineers	✓		
Institution of Mining and Metallurgy	✓	✓	
Institution of Mining Engineers	✓	✓	✓
Royal Institution of Naval Architects	✓	✓	✓
Institute of Physics	✓		
Institution of Structural Engineers	✓	✓	
Chartered Institution of Water and Environmental Management	✓	✓	✓

several more years.

The starting point is the entry of students to accredited (*approved by the Engineering Council as meeting their requirements*) honours degree courses. The usual entry requirement to such courses is a good performance in appropriate subjects at 'A' level GCE, or equivalent (Arbitur). Such courses are usually of three years duration, although so-called sandwich courses are often offered which include a year's experience in industry between the second and third academic years.

After gaining an honours degree, BEng (hons), the students have then to obtain an engineering post in industry, preferably with a firm that provides a coherent training structure in the first one or two years. After two years they should be looking for a promoted post in which they have a measure of responsibility and are expected to be able to work with only general guidelines being set. They may also have responsibility for other staff, or have access to support staff if they should need them. They will be part of a team but will have a degree of independence in how they fulfil its objectives. In SARTOR this stage of their formation is called Initial Professional Development.

Four or five years after they started to work, it is time for them to apply for Chartered Engineer status. This is accomplished by applying to become a corporate member of an appropriate institution. The application form will want a statement of where they have trained and what jobs they have had since graduation. It will have to be supported by two chartered engineers from the institution to which the candidate is applying and a confidential report from a referee who has known the candidate for the previous four years and is familiar with their work. A suitable referee would be their immediate superior at work. If they have changed firms in the previous four years, then it might be appropriate to supply more than one referee. They must also write a 3,000 word report on how their work has formed them as engineers. Note the terminology that is used: their *formation as an engineer*. It is a quite deliberate choice of words - chosen to reflect the British view that an engineer is formed out of the sum total of their experiences, not just the initial training that they have received. After submitting the report, they are interviewed in depth about its contents by two suitably experienced Chartered Engineers, preferably one academic and one engineer from in-

dustry.

The main changes in SARTOR 3 are:

- A requirement for four years of academic study instead of three. This is expected to be met by a four-year MEng degree or by a three-year accredited BEng (hons) degree plus a *matching section*. This matching section must include the equivalent of a further year of full-time study. Although the means by which this is to be achieved can be many and various, the principle aim must be one of broadening to achieve equivalence with MEng graduates. A further feature of the introduction of MEng courses is to be considerably higher academic entry requirements to ensure that the students will be sufficiently able to cope with a higher standard of course content. As a guideline, it is felt that only 20% of current BEng(hons) students would be eligible to enrol for such a course. These changes are going to cause such a major upheaval in British university engineering departments that the new requirements are going to be brought in gradually over a four year period from 1999.
- Initial Professional Development requirements are going to be considerably enhanced. When applicants apply for Chartered status they are going to have to prove that they have acquired sufficient relevant specialist skills and knowledge to be considered competent in their chosen field of engineering. To this end they are going to have to keep an IPD journal in which their records will have to be certified by their immediate supervisor or by a specially appointed engineering mentor.
- The Professional Review is going to be more formalised in that the assessment by the interviewers is to be based on evidence of professional competence set against agreed criteria for the type of work in which they have been involved. This requirement has necessitated the engineering institutions setting up training schemes for their own panels of interviewers. The Professional Review is also going to require the candidate to demonstrate a commitment to Continuing Professional Development and to a professional Code of Conduct and the relevant codes of practice for their chosen field.

The incorporated engineer

Again, the requirements for the training of Incorporated Engineers according to the rules that applied up to two years ago are explained in this section and then the modifications due to SARTOR 3 are presented. Incorporated Engineers are the exponents of today's technology and, as such, they need a detailed under-

standing of a recognised field of engineering. The normal entry requirement has been a satisfactory performance in relevant subjects at 'A' level GCE or in the Ordinary National Diploma. They have then attended either a two-year Higher National Diploma or a three year BEng degree course.

Their Initial Professional Development has usually required five years of relevant industrial experience, again, a period in a training position followed by promoted posts. After five years experience they apply for licentiate membership of one of the main engineering institutions or full membership of one of the incorporated engineering institutions (not listed in Table 1). In either case, they have to submit a professional review and then be interviewed by two engineers, who may be Chartered or Incorporated Engineers.

The principal changes in SARTOR 3 are:

- Three years of academic study, instead of two, as the educational base. It is expected that specialised and more applied degrees will be developed as well as a variety of matching courses, equivalent to one year's full-time study, to enable students with Higher National Diplomas to meet the new criteria. Some of these matching courses will also be needed by BEng (hons) graduates who have decided to follow careers as Incorporated Engineers. They will need vocationally orientated matching courses, as their initial training would not have met the more applied requirements of the Incorporated Engineer.
- Again, Initial Professional Development, Professional Reviews and Continuing Professional Development requirements are being considerably enhanced in a manner similar to those for the Chartered Engineers but in form relevant to their needs.

The Engineering Technician

The Engineering Technician applies proven techniques and procedures to the solution of day-to-day practical problems. They can exercise a measure of supervisory and technical responsibility although they would often work under the guidance of an Incorporated Engineer. They contribute to design, development, maintenance, commissioning and manufacture.

An apprenticeship leading to an approved National Vocational Qualification (NVQ 3) followed by experience plus an appropriate Professional Review can lead to EngTech registration via one of the Engineering Institutions.

CONCLUSIONS

A coherent structure for the formation of engineers

has been developed in Britain over the past 30 years. However, the previous version of SARTOR, which was published in 1990, had been in need of revision because of changed national and international circumstances. The massive expansion in higher education had meant that universities were having to provide courses of many different types and levels. At the same time the nature of engineering has been changing. Combined with these effects has been the development of the global market for goods and services. SARTOR 3 has been developed to enable engineering to cope successfully with these changes and to counteract the drift in standards that has been occurring.

The developments in the British system need to be viewed in conjunction with the increasing internationalisation of our communities. The latest version of SARTOR is going to make tremendous demands upon the universities, the engineering institutions, as well as the people who run them. However, it is only by maintaining a healthy base for the training of engineers that we can successfully maintain standards, vigour in the profession and meet the demands of the 21st century.

REFERENCES

1. The Engineering Council, SARTOR, parts one and

two (1997).

2. HMSO, Report of the National Committee of Enquiry into Higher Education: The Dearing Report (1997).

BIOGRAPHY



George Page was born and went to school in Lancashire in England. He attended the universities of Wales (at Bangor), Manchester and Liverpool. His initial subjects were physics and mathematics but his current teaching and research interests are in the field of intelligent control systems. He has considerable experience in engineering education and has served on numerous national and international committees. He has been an examiner in control engineering for the British Engineering Council, guest editor for several international journals, and is the author of one book and over thirty papers and articles. He is currently with the Department of Electrotechnology of the Fachhochschule Wismar in the Federal Republic of Germany.