ACCREDITATION UNDER NEW SARTOR - A EUROPEAN EXPERIENCE

Melvyn Dodridge[1] and Dr Marios Kassinopoulos[2]

Abstract -- *The raising of standards in the UK by the Engineering Council with their 3rd edition of Standards and Routes to Registration (SARTOR) published in 1997 has caused many institutions to re-think their programmes of study and accreditation status. The UK is already experiencing an increase in the number of bachelor degrees being submitted for accreditation at Incorporated Engineer level and it is the intention that such engineers will form the backbone of our industry and those of many other European countries. The University of Derby in the UK and the Higher Technical Institute (HTI) at Nicosia in Cyprus were the first home/overseas institutions to have programmes accredited under the new SARTOR by the Institution of Incorporated Engineers (IIE). This paper considers the development of the respective programmes and the accreditation issues that led to collaboration between the two institutions resulting in the formulation of a common set of generic learning outcomes and institution specific mapping of skills onto programme content.*

Index Terms – Accreditation, SARTOR, Generic Outcomes, Skills Mapping.

VALUE OF OUTCOMES BASED ASSESSMENT AND ACCREDITATION

A number of models have been developed to define the standard of the output from engineering programmes of study. Models need to relate to the following general criteria:

- Meet the requirements of stakeholders including government agencies, professional institutions, university departments, graduates, prospective students, employers in industry and commerce and society in general.
- Provide a set of generic outcome statements that articulates the output standard of the programme.
- Convey outcome statements in such a way as to provide clear and concise statements to stakeholders.

Outcomes based assessment in its self does not ensure appropriate standards but providing sufficient numbers of programmes accept and use models such as described it is believed that the conventional process of peer group appraisal, comparison and review will, in due course, lead to a consensus view of the acceptable level of the output standard.

Accreditation adds value to a programme of study since in effect it is an additional benchmark thus providing stakeholders reassurance of standards and quality. During a panel session on 'Outcomes based assessment' at the International Conference on Engineering Education (ICEE 2000) the question was asked by one of the panellist, ''What is the standard of an engineering graduate at the end of their programme and how do I know how good the programme is?'' The answer is that it is quite difficult to make comparisons. With the increasing mobility of engineers across Europe and beyond the requirement to make comparisons has never been greater. Whilst countries will have their own accreditation systems such as in the UK with the Engineering Council's charter to licence institutions giving them accrediting powers. Some of the better known institutions have established an international dimension by accrediting programmes outside the UK.

The Institution of Incorporated Engineers is the largest institution accrediting programmes at incorporated engineer and technician engineer level with a growing number of programmes accredited at home and overseas. Where an overseas programme is accredited by a professional institution in the UK it will not only add value but also provide currency in respect of expanding the horizons as far as job opportunities are concerned. For example if someone from overseas seeks employment in the UK with an UK accredited qualification then the prospective employer will know the standard reached.

The University of Derby first gained accreditation for its programmes by the former IEEIE in 1996 whereas the Higher Technical Institute gained accreditation for their Technician Engineer Diploma in Electrical Engineering in 1987. A UK Higher National Certificate (HNC) with endorsements could meet the educational requirements prior to 1999 for Incorporated Engineer (IEng) status. Qualifications offered by both institutions met or exceeded this requirement.

The University of Cyprus will be offering engineering degrees from September 2001 but up and till then the only routes open to Cypriots to enable degree level study was to obtain the Technician Engineer Diploma at the HTI and enhance it with studies abroad, or study in a university abroad at the outset. Many students have pursued their studies in English speaking countries such as the UK and USA, primarily to meet the academic standard required for Chartered Engineer status which at the time was set at the BEng (Hons) level. Two bodies were formed in Cyprus for

[1] Melvyn Dodridge, University of Derby, School of Engineering, Kedleston Road, Derby, UK, m.dodridge@derby.ac.uk
[2] Dr Marios Kassinopoulos, Higher Technical Institute, Nicosia, Cyprus, marios.hti@cytanet.com.cy

the recognition of university and higher education qualifications. The Cypriot Council for recognition of titles of study (KYSATS) was formed in 1996 and is concerned with National academic accreditation. Degrees of the University of Cyprus are of four -years duration whereas diplomas of the HTI are of three- years duration. All other qualifications offered by institutions in Cyprus and abroad are compared by KYSATS with these two institutions, or where this is not possible with universities in Europe, to establish equivalence. The Scientific Technical Chamber of Cyprus (ETEC) deals with the professional recognition and is a similar body to the Engineering Council in the UK. Without ETEC registration it is illegal for Cypriots to work as Chartered Engineers. Unlike the UK the level of Incorporated Engineer is not recognised in Cyprus, however this may change in the future due to the recent raising of standards by the Engineering Council in the UK and because of further harmonisation expected to take place within the European Union. This lack of recognition is the main reason for students wanting to enhance their diploma in order to obtain professional recognition. Nether the less HTI graduates sought recognition of their diploma overseas and an obvious route was through a recognised UK professional institution.

NEW SARTOR

Standards and Routes to Registration (SARTOR) is a policy statement defining the standards of education and initial professional development required for registration with the Engineering Council as Chartered Engineer (CEng), Incorporated Engineer (IEng) or Technician Engineer (TEng). The programmes of study at the University of Derby and the Higher Technical Institute in Nicosia aim to satisfy the increasing demands by industry for engineers at incorporated level.

The 3rd edition of SARTOR [1] published in 1997 that took effect from the start of September 1999 academic year has been substantially revised from the 1990 edition. The new edition reflects changes in the national and international scenes including operation in global markets underlining the need for international recognition of the standard of UK engineering qualifications. The resultant changes raise the standards set by the previous edition by increasing the duration of the educational base from three to four years and from two to three years for the Chartered Engineer and Incorporated Engineer respectively. These changes complement the duration of study stated in the Bologna Declaration [2] published in 1999 in which the standard was set at a minimum of three years for a first degree with additional study of one to two years for a masters degree.

Within higher education the final level for Incorporated Engineer is expressed by the European formula of '3u' where 'u' is the outcome of one traditional year's study at a university level institution. New SARTOR states, for UK national qualifications, the benchmark is a BEng undergraduate programme fully accredited for IEng. It should be noted therefore that the minimum requirement is set at a non-honours degree however there is no intention to limit the title to that of BEng. Many institutions in the UK have accredited programmes with the title BSc and BTech and many will be honours degrees, typically BSc (Hons). The Higher Technical Institute award is titled a diploma but as stated is of three years duration.

The diploma programmes at the University of Derby and the Higher Technical Institute were already accredited under the old SARTOR and so the challenge for both institutions was to meet the new requirements in order to extend the period of accreditation. In the case of the Derby diploma this meant the addition of a matching section of at least one years duration. The Higher Technical Institute diploma is of duration three years like the Derby honours degree programmes and the requirement was therefore to ensure that revisions to the programmes reflected the specific roles set out for the Incorporated Engineer. The HTI wanted to retain international recognition for their diploma and continued accreditation was also a condition laid down by some UK universities to accepting students with good grades onto the third year of their four-year MEng programmes.

A major change in the new SARTOR is the use of an 'outcomes' approach that is designed to provide the basis for the 'programmes specification' recommended by Dearing [3] and now being implemented in the UK by the Quality Assurance Agency (QAA) for Higher Education [4]. Learning outcomes are increasingly being employed in place of learning objectives as a mechanism by which learning achievements are credited. It is possible to place learning outcomes into two broad categories. These are:

(a) Generic programme outcomes that include transferable skills which indicate the overall learning achievements.
(b) Subject related skills which are normally developed within the programme modules and have to be achieved in order to gain credit.

New SARTOR specifies the content of programmes in the terms 'knowledge of', 'understanding of', 'ability to' and 'awareness of' type statements. There is an emphasis on increasing the level of design tasks, project work,

management studies, enterprise and transferable skills and these are reflected in the competence statements.

PROGRAMME DESIGN

Whether designing a new programme or modifying an existing one it is helpful to employ the 'top-down' approach as this involves starting with programme aims that reflect the nature of the programme and from which are generated a set of generic learning outcomes. These outcome statements reflect the overall learning achievements in a programme and are often crafted as an afterthought. This is because the 'bottom –up' approach is often utilised in practise.

In crafting these statements of learning achievement it is necessary to reflect the requirements of new SARTOR and those of the particular institution from whom accreditation is sought. In addition it is necessary to meet the requirements of the educational establishment and other National requirements such QCA Key Skills [3] and OSEng [4] occupational standards in the UK. In Cyprus programmes of study must meet the requirements of the Ministry of Education and the Ministry of Work, the latter having a strong voice regarding the design of programmes offered by the HTI.

Derby took an early opportunity to employ the model proposed by the QAA in 1998[5] in which are specified the four key areas 'knowledge and understanding', 'intellectual skills', 'practical skills' and 'transferable skills'. The generic outcome statements from the previously stated requirements were developed during late 1998 and early 1999 and are believed to be one of the first

examples in the UK to use an outcomes approach. The model comprises a total of nineteen generic statements that are discussed in the light of the future skill requirements required by engineers in [6] and are shown here in Table 1. The programmes were submitted for validation/review and accreditation in the Spring of 1999. The programmes were the first to be accredited by the IIE under the new SARTOR regulations. The use of an outcomes based assessment model was seen as an important step forward at that time as it provided a benchmark for incorporated engineer degrees as the IIE made no specific recommendations on how to present this type of information at the time. Professional institutions
will in due course relate their accreditation requirements to the engineering benchmark statements recently published by the QAA [7]. The four skill areas previously published by the QAA and used in the Derby model however are still valid.

The HTI in Cyprus also submitted their diploma for accreditation in the same period as the Derby programmes but accreditation was subject to two conditions one of which was to draw up an appropriate skills profile identifying and mapping those skills onto modules and industrial placements. The University of Derby agreed to help the HTI and subsequent collaboration involving exchange visits to Derby and Nicosia enabled the HTI to develop their generic outcomes along the lines of the Derby model shown in Table 1.

Each skill can be demonstrated at one or more levels and therefore it is necessary to map these skills against a module(s) of study thus identifying the level(s). The two institutions therefore developed their own maps by mapping the skills onto their respective modules. A section of the map utilised at the University of Derby is shown in Table 2 and that used at the HTI in Cyprus is
shown in Table 3. In both figures a selection of modules is shown from each year of the programmes. Not every outcome is achieved at every level as there is module choice in the programmes and therefore the skills profile of each student will vary slightly. Core modules however ensure that the most important skills are achieved. There has been no attempt at formulating a common curriculum which as been the case in some European projects. The distinctive features of the individual programmes has been retained but a common approach to specifying outcomes coupled with accreditation at the same level has been achieved.

TABLE 1
GENERIC OUTCOMES MODEL USED BY THE UNIVERSITY OF DERBY, UK AND HTI , CYPRUS

(A) Knowledge and Understanding
1. Develop an understanding of engineering and commercial principles and concepts 2. Maintain and Manage Current technology efficiently 3. Take up a role in society with regard to economic and environment sustainability 4. Practice codes of professional conduct, recognising obligations to society, the profession and the environment 5. Extend specialist knowledge in the application of new technologies
(B) Intellectual (thinking) skills
1. Exercise independent technical judgement at an appropriate level. 2. Design, develop and operate products, equipment, processes and services 3. Actively participate in financial statutory and commercial considerations and the creation of cost effective systems and procedure. 4. Use a range of thought processes to identify problems and formulate a number of possible solutions.
(C) Practical Skills
1. Use laboratory scientific equipment and instrumentation competently and safety 2. Observe, record, manipulate and evaluate data 3. Demonstrate the process of experimentation, prototype build and manufacturing 4. Prepare descriptive and interpretative technical reports 5. Demonstrate the use of computer keyboard skills.
(D) Transferable/Key Skills
1. Assume responsibility, as an individual or as a member of a team, for the management of resources and/or guidance of technical staff. 2. Utilise effective communication skills and actively participate in human and industrial relations 3. Utilise Information Technology in the preparation, process and presentation of information. 4. Apply numerical skills in the collection and recording of data, interpretation and presentation of data and the solving of problems. 5. Manage own roles, responsibilities and time in achieving objectives, learning, performance, new and changing situations and contexts.

FIGURE 2
SECTION OF THE SKILLS SET MAP USED AT THE UNIVERSITY OF DERBY, UK

Module Name		A Knowledge & Understanding					B Intellectual Skills				C Practical Skills					D Transferable/ Key Skills				
		A_1	A_2	A_3	A_4	A_5	B_1	B_2	B_3	B_4	C_1	C_2	C_3	C_4	C_5	D_1	D_2	D_3	D_4	D_5
YEAR 1	Quantitative Methods	X								X		X							X	X
	Elec. Meas. & Testing	X																		
	IT & ECAD	X			X	X				X		X	X		X			X		X
YEAR 2	Microprocessor systems		X			X		X		X	X	X			X	X		X	X	X
	Applications programming					X		X		X			X		X			X		X
	Circuit Anal. & Des (Mode A)					X	X			X	X							X		
YEAR 3	Analogue Audio System Des					X		X			X	X	X	X				X		X
	Electrical Drives					X				X	X					X				
	Project (Double)	X			X	X	X	X	X	X	X	X	X	X		X	X	X		X

FIGURE 3
SECTION OF THE SKILLS SET MAP USED AT THE HTI, CYPRUS

Module Name		A Knowledge & Understanding					B Intellectual Skills				C Practical Skills					D Transferable/ Key Skills				
		A_1	A_2	A_3	A_4	A_5	B_1	B_2	B_3	B_4	C_1	C_2	C_3	C_4	C_5	D_1	D_2	D_3	D_4	D_5
YEAR 1	Engineering Mathematics	X								X		X							X	X
	Elect. Eng. Principles	X				X	X			X			X						X	X
	Engineering Practice	X	X		X		X	X		X	X	X	X	X	X	X		X	X	X
YEAR 2	Electrical Installations	X				X	X	X	X	X					X			X	X	X
	Communication Engineering	X			X	X	X	X		X										
	Electronic & Digital Lab.	X	X			X		X		X	X	X		X	X	X		X	X	X
YEAR 3	Industrial Studies	X		X	X				X	X				X	X	X	X			X
	Eng. Software Lab.		X			X	X	X		X	X	X		X	X	X		X	X	X
	Final Year Ind. Training	X	X	X		X	X	X		X	X	X	X	X	X	X	X	X	X	X

CONCLUSIONS

The Sidney Accord presents an opportunity whereby signatory countries recognise each other's accreditation procedures and standards and this will help increase the mobility of engineers on a global scale once they have graduated. At present there are only a small number of countries participating in the Accord due to get underway this June and clearly the number will need to increase significantly in the near future. It must be recognised however that the Accord is not designed to increase student mobility on a global scale during the study period of the programme, for example like the European Erasmus (Socrates) scheme. The European Credit Transfer System (ECTS) attempts to put in place a mechanism for the recognition and transfer of credit but in practice this is limited due to a number of reasons including the recognition of credit where there are variable standards and programme content. The decision to recognise credit is often at the discretion of the programme leader and this in itself can lead to variable standards. ECTS is also limited to European programmes therefore a mechanism needs to be found to recognise credit on a global scale. The development of European modules and programmes is one way of solving the credit issue within Europe but they can be costly to develop and may limit the ambitions of each programme and hinder cultural issues. A number of 'double degrees' however have been developed by various institutions and offer opportunities for study in more than one country outside the Erasmus initiative in Europe and beyond. This type of degree is likely to increase in popularity because the student gains the award of both institutions.

One aim of the Bologna Declaration is the recognition of a European qualifications framework which has an impact on the programme study duration. It is however outcomes and consistent benchmarks that are most important as cultural differences, for example, may lead to variations in study duration. One possible way forward is to generate a global skill map in which standards can be verified by the appropriate accreditation inside or outside the remit of the Sidney Accord. Credit volume would still be important in respect of minimum volumes at certain levels but the prime objective of a skills map is to give a clear picture of the learning achievements so comparisons can be made between programmes of study. Whilst there will be specific skills dependent on the nature of the programme there will be many that are 'generic ' to engineering as a whole and this will not vary significantly from one country to another. There would be an expected minimum level of achievement, for example in mathematics and information technology and communication (ITC) skills. This philosophy is used in the UK with the QAA benchmark statements for engineering [7] and by the Accreditation and Training Board (ABET) in their EC 2000 project.

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