

THE OPPORTUNITIES AND CHALLENGES OF INTERNATIONAL ACCREDITATION FOR THE ENGINEERING PROGRAMMES OF THE UNIVERSITY OF THE WEST INDIES

Clement K. Sankat¹ and David R. McGaw²

Abstract – Graduates of the Faculty of Engineering of the University of the West Indies must engage in an environment characterised by a liberalised, open market economy, where business and manufacturing are transacted in a regional as well as global scale. This is particularly true in the manufacturing, minerals, hydrocarbons and infrastructural sectors. International accreditation of its degree programmes is therefore not an option; it is an imperative. An approach to programme restructuring, based on that proposed by the Engineering Council (UK) in SARTOR (97) is presented which when implemented will provide appropriate engineering training to serve the region whilst at the same time fulfilling the needs for international accreditation. There are however challenges in implementing this approach, these relating to degree nomenclature, costs (both for the students and the University), as well as networking with industry, the other tertiary education providers in the region and the professional associations. These challenges are not seen to be insurmountable and must be met in the quest for benchmarking UWI Engineering training at recognised international standards.

INTRODUCTION

The University of the West Indies (UWI) is a somewhat unique University, in that it serves fourteen (14) island countries throughout the English speaking Caribbean. Engineering training is focussed at one campus, namely the St Augustine Campus, located in Trinidad and Tobago. Thus the Faculty of Engineering has the daunting task of providing trained engineering graduates to service a wide geographical area of islands large and small, and with differing needs.

The economies of the contributing territories vary considerably. In Trinidad, the economy is controlled by the hydrocarbon sector, not only with oil and gas extraction, but also with extensive down stream processing. Gas processing for instance encompasses LNG plants, the operation of a number of ammonia and methanol production units, as well as iron and steel processing. Of significance to the Jamaican economy is the processing of bauxite to alumina with four (4) large Bayer process plants in operation. In addition there are cement plants and sugar production on three (3) of the islands, with food processing and a range of small to medium scale manufacturing locations on most islands. Outside the manufacturing industries enumerated above, tourism is a major factor in all islands; and building and maintaining the tourism plant is an important engineering occupation.

The needs for engineering training are therefore broad based, requiring the servicing of a wide range of manufacturing needs, as well as those necessary for continually upgrading the infrastructure and utilities of all the contributing territories.

With the international nature of the manufacturing industry in the region, owned and run, to some extent, by multinational corporations, it is essential that the level of engineering training at UWI be such that the graduates can perform to the highest level. This requirement has been fulfilled to date with graduates being dispersed throughout all of the islands of the English Speaking Caribbean, and even further afield, especially in Europe and North America. Many UWI graduates are in key positions in the manufacturing industry, construction, utilities (water, electricity, communications), public works, academia and research. From its inception in 1961, UWI has to date produced nearly 5000 graduates in a range of Engineering disciplines namely: Chemical and Process, Civil, Electrical and Computer, Mechanical, Industrial, Agricultural and Petroleum. In all cases the programmes have been specifically designed to meet Caribbean needs.

Up until the 1990's, UWI has been the only provider of professional engineering training in the English Speaking Caribbean. More recently however, the University of Technology (formerly the College of Arts Science and Technology - CAST) in Jamaica has begun to produce graduate engineers. Furthermore, in Trinidad and Tobago, a new institution, the Trinidad and Tobago Institute of Technology (TTIT) is itself preparing to produce graduates in Engineering Technology in the major engineering disciplines.

In the context of these developments, the remit of the Faculty of Engineering of UWI is to produce graduates of the highest calibre, who can serve the profession at the highest level not just regionally but also globally, bearing in mind the global nature of the major industries in the region. It is clear that UWI graduates should be at the pinnacle of engineering training in the region.

In order to ensure that the relevant standards are achieved the Faculty of Engineering at UWI operates a three pronged approach as follows:

- Use of External Examiners for all Second and Third year courses.
- Internal Quality Assurance through Departmental Reviews undertaken by the University's Board for Undergraduate Studies
- International Accreditation by the British Professional Institutions

This paper is concerned with the last approach, i.e. International Accreditation. It describes the history of

¹Clement K. Sankat, University of the West Indies, St. Augustine, Trinidad and Tobago clem@uwi.tt

²David R. McGaw, University of the West Indies, St. Augustine, Trinidad and Tobago dmcgaw@eng.uwi.tt

International Accreditation at the Faculty, discusses the current problems and identifies how these problems are being addressed.

HISTORY OF ACCREDITATION

At its inception in 1961 the Faculty of Engineering at UWI used the External BSc Degree programmes of the University of London, but soon moved to offer its own BSc(Eng) programmes with the entry of the second cohort of students. In general, in order to obtain entry to the Degree Programmes, students had to have completed Advanced level studies with good grades in Mathematics, Physics and possibly Chemistry as examined by the British Examination Boards. With the above in mind, it was appropriate at that time to relate standards to the output from British Universities through the relevant British professional engineering institutions. Contact was made with these institutions and all degree programmes were recognised.

In the early 1980's, however, the British Professional Institutions moved to a more formal and rigorous Accreditation process. The Faculty, recognising the need for its programmes to be accredited, took up the challenge but on a phased basis. Thus the Chemical Engineering programme was accredited first in 1982 by the Institution of Chemical Engineers, this being followed by the Civil Engineering programme being accredited by the Joint Board of Moderation of Civil and Structural Engineers in 1987. The degree programme in Electrical and Computer Engineering was accredited by the Institution of Electrical Engineers in 1990 and those of Mechanical, Industrial and Agricultural Engineering in 1994 by the Institution of Mechanical Engineers. In addition the Faculty has operated an undergraduate programme in Surveying and Land Information (formerly Land Surveying), and this programme has been accredited by the Royal Institution of Chartered Surveyors (UK) since 1990.

The degree programme in Chemical Engineering has to date been reaccredited three times for the full 5 year period at each time, with the other programmes being reaccredited sometimes for shorter periods so as to allow for programme adjustments to be effected. The accreditation exercises by visiting teams have all been invaluable in providing critical evaluations of the programmes and programme delivery including laboratory facilities, student centredness, and professional involvement. These interventions resulted in the relevant adjustments being made to sustain international standards.

The Faculty would have wished to have its programmes accredited in North America, but this was not possible, because the American Board of Engineering Training (ABET) did not introduce accreditation of foreign degree programmes until recently. The Faculty did however benefit from the Washington Accord, where a number of English Speaking countries agreed to recognise each other's accredited programmes.

MAINTAINING INTERNATIONAL ACCREDITATION

In today's ever increasing borderless, fiercely competitive world, with continuous movement of professionals and technology, and with rising technical, managerial and quality standards, continued international accreditation of the Faculty's programmes at UWI is an imperative, not an option. As a region, and with the need to be part of this global activity so as to foster national and Caribbean development, the region's products and services, including training, must be at international levels. The UWI can do no less if it is to contribute to building a better more competitive Caribbean.

UWI benchmarks must be at internationally recognised levels. The Faculty of Engineering must therefore tailor its Engineering Programmes so that they continue to be accredited internationally, whilst at the same time conforming to the requirements of the National and Regional Engineering Associations and Professional Registration Boards.

The Faculty is at the stage where it must raise standards. Bearing in mind its history, as well as the fact that the students enter, in the main, with the same Advanced Level subjects, it is appropriate to continue to target the United Kingdom for international programme accreditation. Of importance in this respect is the fact that The Engineering Council (UK) has modified its approach to registration; the radical changes which have been made being detailed in its Policy Document on Standards and Routes to Registration (SARTOR-97 Third Edition). In this document it is envisaged that future needs for engineering formation and for changes in standards will encompass

- More students of high potential for engineering courses
- More cooperation between schools, colleges, universities and employers
- Better development of management and team-working skills in young engineers
- Higher priority being given to professional development throughout careers.
- Spread of best practice in the use of engineers
- Higher standards of competence and enterprise necessary to meet future challenges

The Engineering Council through its SARTOR (97) document has proposed the following key changes to raise standards in Engineering training compared to the past:

- For Chartered Engineer in a fully accredited programme, four years academic study instead of three as the educational base. The requirement can be met by either a four year accredited MEng degree or, equally, by a three year accredited BEng (Hons) degree plus one year of added learning, called a "matching section".
- The inclusion of stringent entry achievements into the criteria for accreditation of MEng and BEng (Hons) courses in order to ensure a cohort of sufficient intellectual capacity.

While the Faculty has been successfully addressing a number of the formation issues in its current three-year

¹Clement K. Sankat, University of the West Indies, St. Augustine, Trinidad and Tobago clem@uwi.tt

²David R. McGaw, University of the West Indies, St. Augustine, Trinidad and Tobago dmcgaw@eng.uwi.tt

BSc (Hons) programmes, it has to do more to meet the new requirements. In the curriculum of a four year, integrated and fully accredited MEng programme more attention must be placed on the application of creativity and innovation, communication, Information Technology, working in multidisciplinary teams, Quality Management Systems, Health, Safety and the Environment, Management (financial, project, human resources etc), entrepreneurship and leadership. The Engineering courses must also be taught in the context of engineering design, integrating the various facets of engineering training. They must also be taught with greater involvement of industry. These are some of the challenges which the Faculty must address if its graduates are to remain “world class”. In dialogue with the Faculty and University stakeholders within the Caribbean, particularly those from the business, manufacturing and service sectors, these elements of training are crucial for our graduates to become top class performers in the world of work.

The intention of the MEng programme is therefore to produce a broader trained engineer with greater depth and range of specialist knowledge, much more industrially ready and with an educational foundation for leadership, social and business awareness. The MEng programme is intended for students with very high entry qualifications, very motivated and capable of high levels of performance.

THE MENG AS THE BENCHMARK QUALIFICATION FOR CHARTERED ENGINEERING REGISTRATION

To obtain full accreditation by the Engineering Institutions, SARTOR(97) states that the four-year training programmes which lead to MEng degrees in Civil, Mechanical, Electrical and Computer, Chemical and Process Engineering must show:-

Knowledge of-

- The engineering, physical and biological sciences which underpin a range of engineering disciplines. This breadth of knowledge will be a foundation for learning within the particular degree discipline and prepare graduates for work in interdisciplinary teams.
- The in-depth requirements within the discipline of the particular degree.
- The methods providing information for use by others within engineering.
- A wide range of tools, techniques and equipment, including the computer software to the engineering discipline.

An Understanding of-

- Mathematics as a method of communicating results concepts and ideas.
- The principles on which the discipline of the particular degree is based.
- Methods of applying engineering principles to create products, systems and services.

- Constraints in applying technology to create products, systems and services.
- Engineering design methods and their applications.

The Ability to-

- Be creative and innovative.
- Use mathematics as a tool for solving complex problems.
- Use laboratory and workshop equipment to generate valuable data.
- Evaluate and derive information from data to produce useful results.
- Communicate effectively with clients, colleagues and the public.
- Use IT effectively.
- Manage projects, people, resources and time.
- Work in a multidisciplinary team.
- Solve problems of a non-routine nature.

An Awareness of-

- Quality systems and management in engineering.
- Requirements and responsibilities of leadership.
- Obligations to work safely and to apply safe systems of work.
- Risk analysis
- The financial, economic, social and environmental factors of significance to engineering

All of this is clearly appropriate to the training of engineers for the Caribbean and while much of this is being done in the Faculty’s BSc (Hons) programme to achieve the above, a fourth year of value added, higher level and broader training is necessary. However, the fourth year as described by SARTOR (97) must not be ‘bolted’ on, but crucial elements of knowledge, understanding, ability and awareness must be integrated and be allowed to permeate throughout the programme for the desired output. As the Faculty has done in the past (and is currently doing) the above elements of knowledge, understanding, ability and awareness can be encompassed in a schedule of taught, design, research, industry and laboratory oriented courses which embrace the Caribbean realities of today.

In their MEng programme design currently under way, each of the specific disciplines has built in the necessary standards, whilst at the same time recognising the specific needs of the regional environment. All programmes have a major design project, together with an investigative/research project as well as allowing for subject specialisation. A project in industry is also being proposed for certain disciplines. Thus in Mechanical Engineering, whereas a traditional programme is offered, there is also a Manufacturing Engineering stream designed specifically towards providing the engineering training needs for moving the Small and Medium Scale Manufacturing Sector forward in the region. The courses in Electrical Engineering provide specialisations by structuring minors in Communication, Computer, Control, Electronic or Energy Systems. The Civil Engineering

¹Clement K. Sankat, University of the West Indies, St. Augustine, Trinidad and Tobago clem@uwi.tt

²David R. McGaw, University of the West Indies, St. Augustine, Trinidad and Tobago dmcgaw@eng.uwi.tt

programme emphasises Civil Engineering design as a continuous thread throughout the four years and also introduces new courses of relevance to the Caribbean including Coastal Zone Management, Environmental Engineering Design, Road Network Construction etc. The programme in Chemical and Process Engineering has a novel one semester placement in industry with a series of specific management related training modules e.g. human resource management, finance, marketing, quality management, environmental management, built into the attachment.

All the new programmes will include courses in Entrepreneurship and Innovation, in a Foreign Language, in IT for Engineers, and in Communications for Engineers.

THE BSc (HONS) PROGRAMME

The Faculty of Engineering will continue to maintain and promote its traditional three year B Sc (Hons) programmes in all the disciplines of engineering. Such programmes are referred to as BEng (Hons) programmes by SARTOR (97). Because these are of three years' duration rather than four years, they cannot provide all of the depth and breadth, as required for in the MEng. Such BSc (Hons) programmes will continue to provide the basic educational training required of professional engineers, with a foundation of engineering knowledge and understanding, skills and awareness of engineering practice. The Faculty will continue to seek accreditation of its three-year BSc (Hons) programmes, an imperative also dictated by design, as the first two years of the BSc (Hons)/MEng degrees will be common. The Faculty is cognisant of the fact however, that the BSc (Hons) programmes cannot produce graduates who would have completed all the educational requirements for Chartered Engineering registration status, but what is called "interim stage" registration. To go the full distance in terms of educational base, such graduates will have to pursue a "Matching Section". Therefore the BSc (Hons) plus the "Matching Section" will be equivalent to the MEng Degrees in terms of CEng registration. Hence, the Faculty recognises and has been advised by the Engineering Institutions, that graduates of the three-year BSc (Hons) programmes can only be accredited by the Engineering Institutions to a certain level, en-route to full registration. The Faculty is also aware that the current average intake in some of its Engineering Programmes, for example Civil and Mechanical Engineering, will not allow for more than 30% direct entry (i.e. into year 1) into the MEng programmes. It also recognises that the secondary educational base in the different territories of the Caribbean, are at different stages of development. The Faculty is therefore proposing that students who are admitted to the BSc (Hons) programme and who are sufficiently motivated to perform well in the first two common years and at the least at the lower/upper second class honours level, will be allowed if so desired, to transfer into the appropriate MEng programmes.

Through this approach, most of our students will have the option of going into the four-year MEng programme.

It is recognised that SARTOR (97) recommended a 60% performance level at the end of year II for such transfer, and the Faculty must negotiate this hurdle – not an unusual step with Accrediting Teams.

THE MATCHING SECTION

The "Matching Section" required by BSc (Hons) graduates from the University of the West Indies, to complete their educational base for Chartered Engineer registration, must include the learning equivalent of one further academic year of study. The main aim is broadening, to achieve equivalence with MEng graduates, both in foundation learning and specialist enhancement (SARTOR 97). There are a number of means by which this may be accomplished, depending upon the learning needed to complement the particular BSc (Hons) course. For example:

- A one-year MSc course of "postgraduate" level
- A one-year (or equivalent) course in a different field at undergraduate level
- Training and Development Programmes in Industry

The IMechE notes that a "Matching Section" will provide:

- A broader education in engineering
- Versatility
- Greater depth of understanding in the chosen area of specialisation
- More opportunities to develop imagination, creativity and innovative skills
- An enhanced treatment of business and management to provide for more rapid progress to a position of responsibility
- Greater confidence to take on leadership in major engineering projects

Providers of "Matching Sections" must be able to identify where and how each of these attributes are met within the "Matching Section". There may be other options, nor need the "Matching Section" be taken in an academic institution. Programmes provided during employment, whether under the control of the employer or of the qualifying Engineering Institution, are equally valid. The yardstick is the acquisition of the equivalent of an additional academic year of learning of relevance to engineering practice.

The Faculty of Engineering will strive to meet the "Matching Section" needs of its BSc (Hons) graduates through principally the availability of MSc Postgraduate courses which can satisfy some or all of the requirements. The Faculty has traditionally been offering such courses e.g.:

- MSc in Construction Engineering and Management
- MSc in Production Engineering and Management
- MSc in Petroleum Engineering
- MSc in Energy Systems
- MSc in Digital Systems
- MSc in Communication Systems

¹Clement K. Sankat, University of the West Indies, St. Augustine, Trinidad and Tobago clem@uwi.tt

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MSc in Environmental Engineering

As the Faculty develops its complementary Postgraduate programmes, for example the MSc degrees in Chemical Engineering and in Project Management, the learning opportunities required to complement a particular BSc (Hons) course, will increase. The Faculty is therefore not unmindful of the need to provide the required opportunities for its BSc graduates to get Chartered Engineering status if they are so motivated, and will promote this throughout the region principally through its MSc programmes, and a partnership approach between industry, academia and through the professional associations.

IMPLICATIONS IN THE INTRODUCTION OF THE NEW PROGRAMMES

The introduction of the above described programmes will create a new impetus in Engineering Education in the region. There are however a number of challenges which need to be addressed, not the least of which relate to the added costs both for the students and the University.

Thus, students will have to find additional financial support both for fees and accommodation (as well as travel in many cases) to complete the full MEng programme. This is in the context of a system where there are no national grant systems and inadequate externally funded bursaries. This problem is addressed in the proposed BSc/MEng system in that one of its major advantages is that it allows flexibility in student choice as to the route to full professional status. Thus the student who cannot fund the full four years for the MEng programme can obtain the BSc (Hons) and then do the "Matching Section" whilst working in industry.

Additional costs to the University relate to the needs for running additional courses, increased student numbers and the imperative of upgrading laboratory and other support facilities. New lecture rooms together with other learning resource facilities will have to be provided. Each discipline will require additional lecturing and support staff, necessitating a further burden on the recurrent budget. Each discipline will also have to significantly improve its teaching equipment support. In addition, however, each discipline will also have to expand its research activities as these will interface directly with the MEng curricula. The University has responded positively to addressing some of these issues.

Of particular importance to the satisfactory implementation of the programmes is the further development of external relationships and in particular:-

- The other tertiary education systems in the region
- The industrial sector
- International accreditation bodies
- Regional professional associations

Thus, close and formal contact must be maintained with the other tertiary education providers of engineering education in the region. Engineering training programmes across the region must complement each other such that

there is as close to a seamless integration between levels as possible. There should be no impediment to a potential "high flier" from the College system getting into the BSc/MEng programme with appropriate credits given. The advent of the new Engineering Technology degrees in the region provides new challenges for the UWI, one of which is the integration of these with its BEng/MEng and other postgraduate degrees.

Advice on programme design and feedback on the performance of the graduates in the workplace must be provided from the industrial sector. This is best effected by the use of advisory bodies to each of the disciplines. This is an approach, which has been used over the years on a somewhat ad hoc basis, but must be done on a more structured basis in the future if it is to be effective. One of the key issues, which these Advisory Bodies must address, is that of the provision of industrial attachments for students during the degree programmes. Others relate to the provision of professional support to the teaching programmes and financial support for laboratory facilities and research activities.

Mention has mainly been made in this presentation of the continuation of the accreditation of the Faculty's programmes by the Engineering Council (UK). Clearly the enhancement of the relationships between the specific disciplines and their UK Institutions is of prime importance. It is incumbent on the Faculty, however, to investigate the possibility of expanding its international accreditation through other bodies. Of particular importance would be potential accreditation in North America, typically by ABET. Such possibilities will be addressed.

Clearly the Faculty must continue to maintain its extremely close ties with the regional professional associations. Their particular concern would be in ensuring that the Faculty's programmes not only have the requisite standards, but are uniquely appropriate to the regional and local situations. Their inputs would be both through direct contact and/or their Regional Advisory Body to the Faculty which has been in place for a number of years, but also by representation on the Industry Advisory Bodies to the specific disciplines.

The initial feedback from the Professional Associations from the region has been positive, and all are supportive of international accreditation of the Faculty's professional engineering programmes to the highest level. There has however been concern on the title and description by SARTOR (97) of the four year programme as MEng, and at the same time as an undergraduate first degree. This appears as contradictory and likely to be confusing to employers. A more pragmatic approach would be to describe the MEng degree as a capstone of an advanced postgraduate nature. The Higher Education Quality Council of the UK classifies the MEng in the postgraduate category. The MEng in North America is also being seen as an advanced professional degree of a graduate nature. It may therefore be appropriate to award both the BSc and MEng degrees at the end of four years of advanced engineering training. This will avoid all confusion and put the MEng in the proper perspective.

¹Clement K. Sankat, University of the West Indies, St. Augustine, Trinidad and Tobago clem@uwi.tt

²David R. McGaw, University of the West Indies, St. Augustine, Trinidad and Tobago dmcgaw@eng.uwi.tt

SARTOR (97) however notes that the award of double degrees at the end of four years is discouraged. This should be revisited by the Engineering Council in order to move towards maintaining international parity between degrees.

CONCLUSIONS

The continued international accreditation of the Engineering programmes of Faculty of Engineering of the

UWI is an imperative, not an option, in the institution's quest to help build a better more competitive Caribbean. An approach to programme restructuring based on that proposed by the Engineering Council (UK) in SARTOR (97) is presented which, when implemented, will provide appropriate professional engineering training to serve the region and give the students flexibility of choice, whilst at the same time fulfilling the needs for international accreditation.

¹Clement K. Sankat, University of the West Indies, St. Augustine, Trinidad and Tobago clem@uwi.tt

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