Engineering Technology: A Malaysian Case

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**Index Terms:** Engineering technology, accreditation, technologist.

**Abstract:** The current and rising challenges in engineering technical education demand graduate engineers who are well-prepared to provide innovative solutions as technical specialists, system integrators and change agents. As a result, technical engineering education has necessitated the accessibility, flexibility and challenges for quality and accredited engineering programs. Realizing the importance of producing a highly competent manpower to support the move towards a knowledge-based economy, the Malaysian government has put considerable pressure to the universities to produce engineers who are competitive in the global market. Hence, this paper evaluates the universities’ response towards the assignment of developing a highly competence engineering technology workforce in support of the government policy. It examines how a case study university charts its route towards this direction through its implementation of engineering technical education. Specifically, it analyses the faculty planning and future direction in the use of hands-on skills in teaching and learning. This paper also investigates the obstacles and barriers by university management in dealing with issues concerning national quality assurance and accreditation pertaining to the engineering technical education programmes. A key conclusion of this research is that Malaysian universities need to evaluate its engineering technical education strategies if they aim for quality assurance and accreditation to be established and aspire for successful attempts towards the creation of the requisite knowledge workers that Malaysia’s needs.

1.0 Why Engineering Technology?

“Science, engineering and technology (SET) are all essential to finding solutions to many major issues and challenges we will face in the future. Therefore, it is good to see the valuable work that the Engineering and Technology Board have been carrying out in areas of growth capital provision in the UK to SET based companies”.

Rt Hon Tony Blair MP, as Prime Minister [1]

The above is the statement from the previous British Prime Minister with regards to the contribution of science, engineering and technology towards the pace of engineering and technological changes in Britain. Evidently, as suggested by the above statement, investment in SET is part of the economic development policy of a nation as it determines the rate of economy and integration in world markets [2]. The Malaysian case is no exception. The current development demonstrates that engineering education in Malaysia is reactive and responding to change [3][4]. Engineering education plays an important role to shape the significant and dynamic role of the profession especially for the growth of human capital in the country [5][6]. The skills and abilities of Malaysia’s population are a key source for the nation’s continued prosperity. Science, engineering and technology skills are vital as they provide the basis for an innovative and globally competitive workforce. The developments of skills contribute to the growth of industry and research sectors and in turn affect the growth and
productivity of the economy. As a result, there is a paradigm shift in Malaysian education which involved all fields of study to support the country’s entry into knowledge age [7][8].

The changing role of engineers in the era of globalization of industry and the engineering practice as well as the increased use of technology in education has had an immense impact on the economy of a nation [9][10][11]. Alas, graduates’ competence in those environments has not been significant in many engineering programs. Engineering technology of applied engineering fundamentals and inclination towards addressing practical engineering problems by applying innovative solutions can provide leadership in the globalization of engineering technology education. With its roots in theory-application, and the increasing inclusion of technology into all aspects of society, engineering education is well positioned to contribute to current global technical educational demand [12].

With the current technological advancements in the engineering field, qualified workers become the standard market requirement [13]. Most importantly, graduates with skill-based orientation have a better probability of getting higher wages. In promoting programs such as engineering technology, institutions have to adapt to the market relevance and current needs. As a result, changes and modifications on entry qualifications, academic systems and modes of instruction, among others need to be reviewed by the respective universities [14][15].

Engineering education has gradually shifted in the emphasis from professional skills to process skills. Many practicing engineers and technologists might lack theoretical knowledge but possess practical skills. The import of talented and skilled engineering technology professionals from overseas is not a long term solution to the problem faced by the industries. The development of skill-based technology training is an important strategy to expose students to real working life and equip them with the necessary skills so that they will be job ready after they graduated. Attempts have been made to develop the engineering technology path for a highly competent engineering technical workforce. What is the scenario in Malaysia? Does the Malaysian education system place too much emphasis on skills or theories? These issues are further discussed in the following sections.

2.0 Engineering Technology in Malaysia

Institute of Engineers Malaysia (IEM) plays as an advisory role to the professional associations in the country and works in tandem with the engineering technology profession. Debates concerning professional registration of engineering technology graduates in Malaysia have been highlighted. These include:

- The incorrect term for engineering technology. Cheshier [10] suggested that ‘applied engineering’ would be better description to differentiate it from the standard engineering practice.
- The four-year practice of standard engineering curriculum – less applied knowledge with fewer laboratories should be taught.
- The Institute of Engineers Malaysia and Board of Engineers Malaysia are very stringent on the issues of licensure and professional registration. Denying these graduates to become professional engineers will place a barrier to realize their full engineering potential and the advancement of their profession.
- The Washington Accord agreement covers only professional engineering graduates whereas engineering technology is embraced by the Sydney Accord.

Engineering Technology needs to distinguish themselves from engineering programs by addressing areas that will develop Engineering Technology programs into stand-alone programs, working in association with engineering and technical programs. One approach is to create separate registration path between the engineering and engineering technology workforce with different scope functions. Refer to Fig.1 below for the spectrum of jobs and jobs function stipulated by the University of Florida [16]:

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The scope of practice can be tallied with the existing definition of engineering technology as used by ABET [17]:

“Engineering technology is that part of the technological field which requires the application of scientific and engineering knowledge and methods combined with technical skills in support of engineering activities; it lies in the occupational spectrum between the craftsman and the engineer at the end of the closest to the engineer. The term ‘Engineering Technician” is applied to the graduates of associate degree programs. Graduates of baccalaureate programs are called “Engineering Technologists”

Further definition on the scope is offered by ABET [18]:

Engineering problems require solutions of varying degrees of complexity and non-technical considerations. As the technical leader, the engineer determines the policy basic to technical solutions and exercises responsibility to society in the non-technical dimensions. The technician and the technologist work in many functional and responsive ways to execute the applications designed by the engineer.

This paper will therefore refer to engineering technology as defined by ABET in the above definition.

3.0 Quality Assurance and Accreditation of Engineering Technology Programmes in Malaysia

The accreditation of engineering programmes in Malaysia is under the jurisdiction of the Engineering Accreditation Council (EAC). The EAC is formed by the Board of Engineers Malaysia (BEM), the government body which has the legal responsibility of registering and regulating the engineering profession in the country. The EAC derives its membership from the Institution of Engineers Malaysia, Accreditation Board of Malaysia, the Public Services Department of Malaysia, the Malaysian Council of Engineering Deans, and several members appointed by the President of the BEM from among industry practitioners.

The accreditation system for engineering education is undergoing a major improvement exercise through a series of visits, discussions and seminars conducted by BEM. Below are the critical issues gathered subsequent to the exercise:

- Inconsistency in the accreditation criteria and its manual

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• Lack of clarity in the documentation requested from respective universities
• The credibility of the panel evaluations members
• The training of the panel members
• The awareness of outcome assessment education from the stakeholders.

Some actions have been taken by the EAC to address the above subjects including revising the Engineering Programme Accreditation Manual and Appendices to remove the inconsistencies and to clarify the purpose and expectations of engineering accreditation system. Series of training programs for members of the Board of Engineers, the Engineering Accreditation Council, the accreditation panel chairs and members have also been conducted. Similar training was provided for engineering deans, department heads, and faculty members all institutions.

All of the issues and continuous improvement merely reflect the undergraduate engineering programs in Malaysia. Very few literatures have discussed the undergraduate engineering technology program in Malaysian higher institutions. In this regard, CST has decided to abide by ABET requirements and will seek recognition by EAC and BEM in the near future. The following section will analyze the development of undergraduate engineering technology programmes in CST.

4.0 The Case of College of Science and Technology

College Science and Technology (CST) is a branch campus of Universiti Teknologi Malaysia (UTM), Malaysia’s premier university in science and technology. CST is located in Kuala Lumpur and was formed in June 1995. It aims to produce semi-professionals in the fields of engineering, sciences, technologies and managements [19]. The college offers 16 courses with an enrolment of 5000 students. Currently there are five departments housed under CST namely:

• Department of Civil Engineering
• Department of Electrical Engineering
• Department of Mechanical Engineering
• Department of Management and Services
• Department of Science and Computers

Since 2005, CST has initiated and developed programs involving technology education in engineering as a gesture of support towards the country’s demands and to address and response to globalization issues. An initiative was taken by faculty members to derive programs to support the need. Hence, new academic programmes are being created, such as the Bachelor Engineering Technology in Civil, Electrical and Manufacturing which fall under three departments in CST. CST is expected to recruit new students immediately after the permission from the Ministry of Education of Malaysia has been granted.

The following factors contribute to the development of these programs:

• Limited number of engineering places available in Malaysian universities.
• Entry requirements of engineering technology programme are lower than the normal engineering programme. However, it is still fulfill the minimum requirement for engineering courses stipulated by the Ministry of Higher Education (MOHE) of Malaysia.
• Students’ increased appreciation of technologically dynamic courses as compared to the engineering proper.
• Engineering courses are regarded as boring and difficult when compared to technology-based engineering courses.
• A gradual decline in traditional manufacturing industries accompanied by the growth in the service sector. This resulted in different job skills and educational emphasis.

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Comparisons have been made with engineering qualifications framework and education models worldwide in order to produce graduates who can compete in the global engineering market while remaining competitive with the other professions in the country. This has resulted in the recent formation of the Malaysian Qualification Framework (MQF). MQF is a comprehensive framework that oversees the appropriate level and scope of curriculums from stakeholders including students, employers and lecturers. Its function is to identify the linkages of learning programmes offered in Malaysian universities. Hence, a route map to the engineering technology education was created to fill the gap between the engineers and technical assistants [20]. Below are the objectives of MQF:

- securing the standards of qualifications and reinforcing policies on quality assurance
- ensuring accuracy and consistency of nomenclature of qualifications
- supporting flexible education by providing typical learning pathways and recognizes prior learning (RPL)
- encouraging partnerships between public and private sector
- linking non-degree with undergraduate and postgraduate levels
- encouraging parity of esteem among academic, professional and vocational qualifications
- establishing a common exchange for credit accumulation and transfer
- providing clear and accessible public information
- facilitating the presentation of the intended outcomes of qualifications will enable professional bodies to gauge the contribution to professional formation and articulating links with qualifications from other countries.

With regards to institutional output of engineering graduates, ABET has highlighted that graduates of Bachelor of Engineering Technology should be able to:

- Demonstrate an appropriate mastery of the knowledge, techniques, skills, and modern tools of their disciplines
- Apply current knowledge and adapt to emerging applications of mathematics, science, engineering and technology
- Conduct, analyze and interpret experiments and apply experimental results to improve processes
- Apply creativity in the design systems, components and processes appropriate to program objectives
- Function effectively on teams
- Identify, analyze and solve technical problems
- Communicate effectively
- Recognize the need for and posses the ability to pursue lifelong learning
- Understand professional, ethical and social responsibilities
- Recognize contemporary professional, societal and global issues and aware of and respect diversity
- Have a commitment to quality, timeless and continuous improvement.

The Institution of Engineers (IEM) and the Malaysian Council of Engineering Deans (MCED) have accepted the above attributes as requirements for Malaysian engineering graduates. BEM has specified that the minimum number of credits for graduation is 120 credits, of which 80 credits must be allocated to engineering and its related subjects. CST has conformed to this condition. To illustrate, one credit hour comprises of one lecture hour per week. As for laboratories, workshops and studios, a credit is equivalent to two or three contact hours per week, and for tutorials it is one contact hour per week. In this case, CST has included industry related courses in term of design project and practical training in its course design.

5.0 Challenges facing Engineering Technology Education at CST
Several challenges awaits as CST ventures into this new undertaking. Firstly, CST must provide more industrial-related problems in applying the understanding of the changing requirements of industry in order to attract and maintain the motivation of engineering students. Practical application, theoretical understanding, creativity and innovation are seen as the top priorities for these graduates to master in. Other anticipated challenges facing engineering technology at CST are:

- Broad-based undergraduate programs for easy mobility
- Flexibility to adapt to new changing technologies
- Dynamics curriculum
- Turning theory into practice
- Promoting inter and cross-disciplinary research
- Intensifying research-based education
- Emphasis on continuing lifelong education

Adapting programs to the industrial needs is not an easy task. Academia does not change easily, particularly when addressing interdisciplinary requirements and in understanding what and how to change. Hence, it is a challenge for both the academics and the industry to find a common platform in order to converge on their diverse understandings.

Another challenge is the limited partnership between industries and universities. This has resulted in the difficulty to recruit quality faculty members, specifically experienced engineers. In addition, many research finding have not been commercialized, resulting in structural inefficiencies that impair a university's ability to adapt and change.

Inadequate financial support is another demanding matter. Significant amount of financial allocations are needed to materialize the engineering technology programs in CST. Existing infrastructure such as classrooms, laboratories, computer laboratories including Internet and information infrastructure need to be improved and upgraded in order to accomplish the programme educational objectives in an atmosphere conducive to learning.

### 6.0 Conclusion

Engineering education needs to be re-engineered by taking into account the emerging trends in the inputs, the output requirements, the environments, and the strategic goals. The new paradigm for Engineering Education is emerging as a multi-disciplinary, multi-mode, multi-media and multi-partner enterprise.

Engineering Technology in the Malaysian case, as demonstrated by the case study, should look into the job functions and knowledge shifts that have influenced the teaching pedagogy as well as the teaching methodologies. Engineering technology must recognize the uncertainty facing the engineering and technology profession because the effects of the emerging global economy onto the profession are massive.

Malaysia has secured a Provisional Membership of the Washington Accord for undergraduate engineering programs and is on its way towards applying for full signatory status. For undergraduate Engineering Technology Programs, the needs to prepare for the admission into the Washington Accord can be carried out by understanding the need for the implementation of a major culture change in the engineering education system. This change will inevitably contribute towards strengthening quality assurance for graduates’ outcomes, thus making the effort desirable regardless of membership status. Malaysian universities need to re-evaluate its engineering technical education strategies if they aim for quality assurance and accreditation to be established and aspire for successful attempts towards the creation of the requisite knowledge workers that Malaysia needs.

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