The review of current engineering and technology programme accreditation in Taiwan

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ABSTRACT: Over recent decades, the business of programme accreditation has received considerable attention. Accreditation activity in Taiwan increased sharply after the reform of the higher education evaluation policy. This study reviewed the current engineering and technology programme accreditation in Taiwan by adopting both quantitative and qualitative methods. In addition, the subjects of this study were the departments and institutes that had been approved by the Institute of Engineering Education Taiwan (IEET) during the period from 2004 to 2013. The types of schools, departments and fields were analysed through the use of descriptive statistics. The conclusions reached are proposed as topics appropriate for future studies.

INTRODUCTION

With the on-going trend of ensuring graduates' global competency, the issue of accreditation has become increasingly popular since 1998 [1]. In particular, the industrially-advanced countries generally think highly of maintaining the quality of engineering and technology education, and the government has encouraged colleges and universities to seek international accreditation [2]. On the other hand, the issue of promoting international exchange and cooperation is also valued. Even though the economic and industrialisation growth in Asian countries is faster than elsewhere in the world, the implementation of a quality assurance mechanism in engineering education has been much slower in these countries [3].

In Taiwan, some higher educational policies have been abused. Schools, departments and institutes have been continuously established in recent decades. According to statistics from the Ministry of Education (MOE), the number of universities (including colleges) in Taiwan increased from 150 to 162 since 1990. This situation has called into question the quality evaluation of higher education, and also led to demands for improved school quality assurance and for the need to increase students' core competency. In recent years, many graduates find themselves unable to obtain employment immediately, and there is a gap between what they have learnt from school and what industry perceives its needs as being. This is a serious issue in Taiwan.

Therefore, in order to deal with the time vicissitude in the internal industries, and also to face the global inter-industry competition, it will be essential for a policy of programme accrediting the quality assurance in higher education and human resource development to be constructed and implemented. In addition, since the University Act was promulgated from 1994, the laws and regulations related to the Act have pronounced clearly that the responsibility for evaluating universities rests with the MOE. Therefore, the MOE's policy promotion of higher education evaluation has been more active in recent years, and by implementing a process to promote educational quality and, hopefully, to raise the total quality assurance of higher education in Taiwan.

Taiwan's higher education evaluation, both in the general and vocational education systems, was originally based on the *Regulations Governing University Evaluation*, which were released in 2007. In the early stages, the leading role in higher education evaluation was played by the MOE, but it has authorised the professional institutes or civil societies to arrange related matters. For example, the Higher Education Evaluation and Accreditation Council of Taiwan, the Taiwan Assessment and Evaluation Association, and the Institute of Engineering Education Taiwan are the organisations that have been authorised by the MOE to deal with educational accreditation.

In Taiwan, all departments and institutes of higher education are required to be periodically accredited and evaluated by the approved educational evaluation organisations, and among these institutes, the Institute of Engineering Education

Taiwan (IEET) is responsible for engineering education. The IEET was founded in 2003, and it comprises engineering and technology educators and, therefore, it received strong support from the MOE. Furthermore, the aims of this organisation were to establish a Taiwanese engineering and technology education certification programme and to ensure the quality of the higher education in Taiwan, so it is on a par with international standards [4].

On 21 June 2000, the MOE formally chartered the IEET as the sole window for contact on issues related to the accreditation of engineering and technology education programmes. In addition, the departments and institutes that grant accreditation can apply for remitting the accreditation by the Higher Education Evaluation and Accreditation Council of Taiwan according to the Regulations Governing University Evaluation. IEET accreditation is a non-government, peer-review process with a student-outcomes based orientation, and one of the purposes is to determine if a degree-granting programme meets certain standards of quality [5]. The IEET accreditation of engineering and technology programmes has four characteristics: core competency, continual improvement, industry-academic cooperation, and gear to international standards. Among these characteristics, to gear to international standards is the most important component, and it has a great effect.

The Washington Accord was signed in 1989, and it recognises substantial equivalence in the accreditation of qualifications in professional engineering. Therefore, it is an important global consortium for engineering education accreditation. Additionally, the main objective of the Washington Accord is to recognise the substantial equivalence and accreditation system of various organisations and engineering education programmes in the signatory countries [6], and the IEET was advanced to the Washington Accord as a full signatory in 2007. Accordingly, the IEET's entry into the Washington Accord ensures three important aspects: 1) domestic diplomas will be recognised; 2) domestic graduates will be able to apply for foreign certificates of professional engineers; and 3) domestic technicians will be able to apply for the certificates of APEC Engineer [7].

HIGHER EDUCATION PROGRAMME ACCREDITATION IN TAIWAN

The IEET has been responsible for the accreditation of engineering and technology programmes since 2004. And, there have been five types of accreditation: Engineering Accreditation Criteria (EAC), Technology Accreditation Criteria (TAC), Computing Accreditation Criteria (CAC), Architecture Accreditation Criteria (AAC) and Design Accreditation Commission (DAC). However, the DAC is a brand new programme accreditation, and it will be released in 2014; consequently, there has been very less information available so far. Therefore, this article is mainly focused on the other four accreditation types. Moreover, the professional fields in each type are different, and the criteria are different as well. In addition, these four types of criteria are treated equally and fairly. Thus, the departments and institutes of the higher educational schools in Taiwan can choose the most suitable accreditation according to the contents of their programmes.

Engineering Accreditation Criteria (EAC)

The EAC was the first accreditation programme, and the criteria were approved by the accreditation council, and the accrediting contents followed the criteria of the Washington Accord and the standards of the Regulations Governing University Evaluation. The scope of evaluation is to accredit programmes if they are aimed at developing professional engineers. Therefore, it should provide appropriate curriculum to satisfy students' development in their professional field. More specifically, mathematics and basic sciences must account for at least a quarter of the credits required for graduation, and the technical and professional component must account for at least three-eighths of the credits required for graduation [5].

Technology Accreditation Criteria (TAC)

The scope of the TAC differs from that of the EAC. More specifically, the TAC aims to construct the programmes that develop engineering technologists. Therefore, the human development of technology expertise and practice-orientation is important to the TAC. On the other hand, the TAC emphasises that academic staff must have the qualifications and competency to cover the professional knowledge of the subject areas in which they teach.

About the credits required for graduation between the EAC and the TAC, mathematics and basic sciences must be appropriate to the attainment of the programme educational objectives and training of students for technical practice of the discipline. Moreover, the technical and professional components that train students to be proficient in technical practice must account for at least three-eighths of the credits required for graduation [5].

Computing Accreditation Criteria (CAC)

The scope of the CAC is to accredit the programmes of computing or IT-related professional engineering; therefore, information management and information science are accredited by the CAC in Taiwan. Thus, in the criterion of curriculum, mathematics appropriate to the discipline must be consistent with the programme's educational objectives and must account for at least nine credits required for graduation, and the technical and professional computing component must account for at least three-eighths of the credits required for graduation [5].

Architecture Accreditation Criteria (AAC)

The AAC is the authority for accrediting professional programmes in architecture, and the main idea is to promote and enhance the architecture education. Furthermore, it aims to connect with key internal and external architecture education bodies, moreover, to enhance the students' competency to compete with others. Therefore, the AAC ensures that graduates are provided with relevant qualifications, core knowledge and abilities. For now, there are 30-40 departments and institutes of architecture in Taiwan, and one-third are approved for accreditation.

However, the EAC from the IEET does not meet the whole needs for the architecture departments and institutes, therefore, the IEET referred to the Canberra Accord, National Architectural Accrediting Board (NAAB), Architects Accreditation Council of Australia (APEC Architect), and the Senior Examination for Architects of the Examination Yuan of the Republic of China to propose the AAC. In the criterion of curriculum, the AAC is radically different from the CAC, EAC and TAC. The AAC requires the design and content of the curriculum to be consistent with the programme's educational objectives and must include at least the following elements: humanities, social sciences, basic science, professional architectural topics and general education [5].

With the exception of the above mentioned, all of the IEET authorities assess the programmes' plans and effectiveness for self-evaluation, development and improvement, as shown in Table 1 [5-6].

Table 1: The summary of the programme accreditation types.

Accreditation type	Accord	Approved programme numbers	Starting year	The standards of students' core competencies	
				Different Criteria	Common Criteria
EAC	Washington Accord	811 (99.8%)	2004	1. Ability to apply knowledge of mathematics, science and engineering. 2. Ability to design and conduct experiments, as well as to analyse and interpret data. 3. Ability to use techniques, skills and tools necessary for engineering practices. 4. Ability to design an engineering system, component or process.	1. Ability to manage projects, communicate effectively and function on teams. 2. Ability to identify, analyse and solve problems. 3. Knowledge of contemporary issues. 4. Understanding of professional ethics and social responsibility.
TAC	Sydney Accord	2 (0.2%)	2011	1. Ability to apply with familiarity of knowledge, techniques, skills and current tools required for practice of the discipline. 2. Ability to conduct standard operating procedures and to conduct, analyse, interpret and apply experiments to improve technical practice. 3. Ability to apply innovation in technical practice.	
CAC	Seoul Accord	5 (0.6%)	2011	1. Ability to apply and innovate knowledge of information technology and mathematics. 2. Ability to use techniques, skills and tools necessary for information technology practices. 3. Ability to design and evaluate computerised system, process, component or programming language.	
AAC	Canberra Accord	3 (0.4%)	2011	1. Ability to apply creativity, aesthetics and knowledge in architectural design. 2. Ability to investigate, evaluate, translate and integrate a design concept into built form. 3. Ability to plan and practice an architectural project.	

ANALYSIS OF THE CURRENT PROGRAMME ACCREDITATION STATUS IN TAIWAN

Currently, there are 77 schools offering 821 programmes which have been accredited, and the numbers on the approved list is 40 times larger than it was in 2003. Obviously, the universities and colleges have paid more attention to engineering and technology accreditation. Moreover, according to the statistics analysis, 264 programmes offered by public colleges and universities were accredited. In other words, the public colleges and universities had a better circumstance in programme accreditation, and represented 32.16% of all approved programmes. Next, 233 programmes (28.38%) in the private universities had been approved. In addition, the approved number of the private vocational and technological colleges and universities was 185 which represented 22.53% of the total. Finally, the number of national vocational and technological colleges and universities on the approved list was 139 programmes (16.93%).

Comparing the public and private schools, 403 programmes have been approved in public schools, representing 49.09% of all, and private schools offered 418 approved programmes (51.91%), as shown in Table 2, and further illustrated in Figure 1. According to the data analysis above, there is no significant difference between the public and private schools.

Moreover, in the general and vocational schools, there are 497 approved programmes in the general universities, 60.54% of the total.

Table 2: The summary of the programme accreditation numbers during 2004 and 2012 by school type.

Year	Numbers of the approved programmes	College and University			Vocational and Technological College and University		
		Sum	Public	Private	Sum	Public	Private
Awaiting Accreditation	2	2	1	1	0	0	0
2012	40	31	10	21	9	1	8
2011	154	102	59	43	90	40	52
2010	55	43	26	17	12	12	0
2009	116	75	59	16	41	23	18
2008	151	77	37	40	74	29	45
2007	175	103	48	45	72	35	37
2006	41	28	12	16	13	3	10
2005	35	26	15	11	9	6	3
2004	22	10	0	10	12	0	12
total	821	497	264	233	324	139	185

Note: *Awaiting Accreditation* is the department or institute that has not had graduates yet

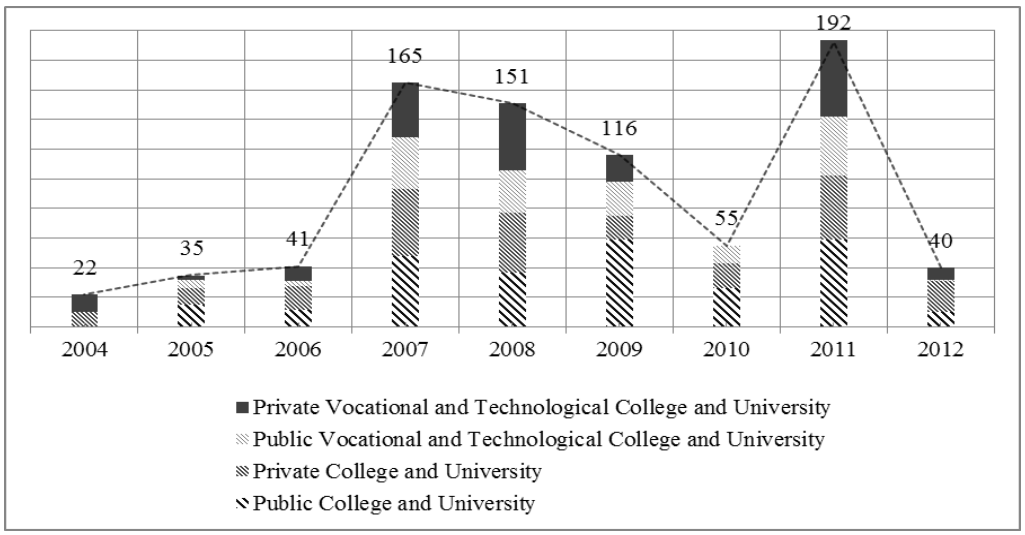

Figure 1: The trend chart of the approved school types.

In the ratio of the approved academic categories, Civil Engineering had 103 (12.55%); Electrical and Electronic Engineering had 199 (24.24%); Mechanical Engineering had 162 (19.73%); Chemical Engineering had 107 (13.03%); Computer Science Engineering had 115 (14.01%); Cross-disciplinary Engineering had 121 (14.74%), and the others had 14 (1.70%) in the nine years. Details are shown in Table 3, and Figure 2 shows the distribution diagram of the approved list in departments and institutes.

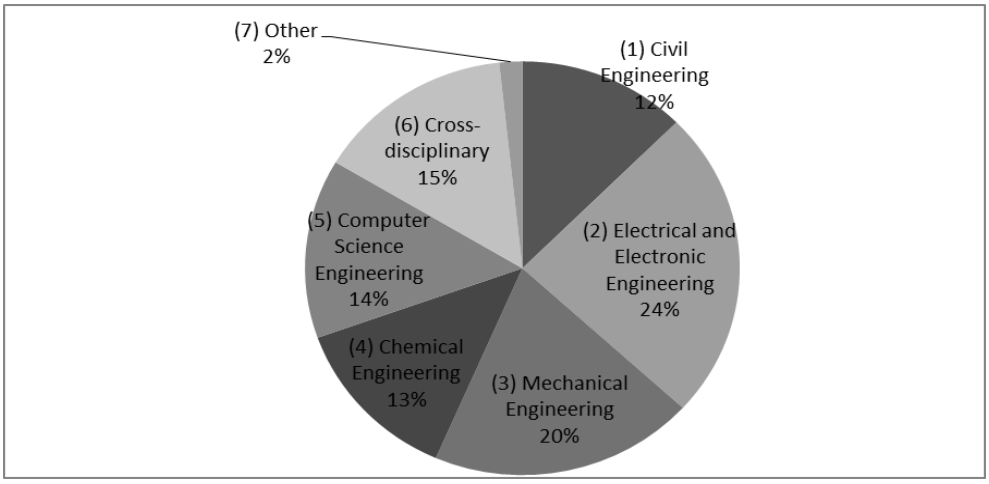

Figure 2: The distribution diagram of the approved list in departments and institutes.

Table 3: The Summary of the programme accreditation numbers during 2004 and 2012 by academic categories.

Year	Academic categories						
	1	2	3	4	5	6	7
	Civil Engineering	Electrical and Electronic Engineering	Mechanical Engineering	Chemical Engineering	Computer Science Engineering	Cross-disciplinary	Others
Awaiting Accreditation	0	1	0	1	0	0	0
2012	2	12	3	1	11	9	2
2011	30	49	39	30	21	21	4
2010	0	19	12	2	14	8	0
2009	18	24	22	13	15	23	1
2008	18	35	26	17	26	25	4
2007	25	40	36	32	18	22	2
2006	2	11	9	5	6	7	1
2005	7	5	13	5	2	3	0
2004	1	3	2	1	2	3	0
Total	103	199	162	107	115	121	14

Note: 1) Civil Engineering (including Surveying Engineering, Environmental Engineering, and Harbor and River Engineering); 2) Electrical and Electronic Engineering (including Automatic Control Engineering); 3) Mechanical Engineering (including Industrial Engineering); 4) Chemical Engineering (including Materials Engineering); 5) Computer Science Engineering (including Computer Science, the Internet, Software Development, System Design, Computer Application and the related programmes); 6) Cross-Disciplinary (including Biomedical Engineering, Integrated Engineering, and other engineering related programmes); and 7) others (including Design and Architecture)

CONCLUSION

This article described the current status and the trends of programme accreditation in Taiwan's higher engineering and technology education. According to the research findings, the numbers of departments and institutes in the approved list has been increasing year by year. There are fewer schools in the general colleges and universities (67 schools) than in the vocational and technological colleges and universities (95 schools) [8]. However, the department and institute numbers on the approved list in the general colleges and universities are much more than the numbers in the vocational and technological colleges and universities surprisingly.

One of the possible reasons is that EAC was the only accreditation to be promoted in the early years. Furthermore, the curriculum in the general colleges and universities had more academic courses, and the vocational and technological colleges and universities were more focused on technical courses. In other words, the ratio of academic course credits in the general schools was higher than in the vocational and technological schools; nevertheless, it was not advantageous to the vocational and technological schools due to the accreditation types. Since the assessment and evaluation in higher education were released, many scholars have appealed for the accreditation types to be reclassified according to different school types by research, teaching and practical universities.

The IEET established the TAC to reflect the demands of the practical schools; however, this is in its early stages, and the numbers of schools applying are less and, therefore, the accreditation effects are still unknown for now. Only the engineering-related departments and institutes that train and develop students to have the core competency to be a professional engineer can be successful in the accreditation process and, moreover, the graduates can be geared to international standards.

According to the approved list of departments and institutes, the ratio of electrical and electronic engineering related departments and institutes is higher, and it can be referred to as being industry-oriented. Additionally, Taiwan is famous for electronic products and is so-called the Green Silicon Island; therefore, industry's demand for ET graduates is huge [1]. It has shown that the above mentioned departments and institutes tend to take the accreditation seriously. Moreover, if a department or institute can be approved in the programme accreditation, then, university programme evaluation is not needed. In the long term, the effect is much more obvious to see. However, some academic degrees are not identified as being formal ones, so as long as the departments or institutes grant the accreditation, then, it will provide a boost for international competitiveness.

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