Pertanika J. Soc. Sci. & Hum. 24 (S): 167 – 184 (2016)

PERTANIKA JOURNALS

SOCIAL SCIENCES & HUMANITIES

Journal homepage: http://www.pertanika.upm.edu.my/

Designing a Reliable Academic Quality Management System in Nurturing Future Engineering Professionals – A Case Study

Abdul Rahman Mohd Yusoff[1]*, Juwairiyyah Abd Rahman[1] and Mohammad Syuhaimi Ab-Rahman[2]

[1]Spectrum Technology Research Group (SPECTECH), Department of Electrical, Electronic and System Engineering, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia
[2]Deputy Dean Office, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia

ABSTRACT

Engineering quality system among local universities has undergone stiff competition in reflecting the outcomes of education. The capability of each university of maintaining their academic structures must be given attention in order for it to stay competitive. The purpose of this paper is to develop a reliable academic quality management system for accreditation of engineering education based on EAC and MQA requirements. The main structure includes the institutional engineering curriculum, co-curriculum, governance and a systematic documentation system. The stakeholder inputs are used as elements in responding to industry and government needs. Reviewing inputs, self-assessment reports (SAR), different best practices and additional inputs helped in supporting and strengthening this academic quality management system. Three main planning elements were involved namely, establishment, assessment and continuous improvement stages. With the development of reliable academic quality management, engineering knowledge, skills and attitudes can be further enhanced to improve the quality of our graduates. The model can significantly become a platform for maintaining accreditation as well as sharing some best practices for other institutions offering similar programmes. As such, engineering education is set to reach greater heights in producing right human capital assets in nurturing future engineers.

ARTICLE INFO

Article history:
Received: 09 October 2015
Accepted: 31 March 2016

E-mail addresses:
abdrahman.mdyusoff@yahoo.com (Abdul Rahman Mohd Yusoff),
juwairiyyah@unisel.edu.my (Juwairiyyah Abd Rahman),
syuhaimi@ukm.edu.my (Mohammad Syuhaimi Ab-Rahman)
* Corresponding author

Keywords: Accreditation, academic quality management system, Programme Educational Objectives (PEO), Programme Outcomes (PO), graduate attributes, quality assurance, Continuous Quality Improvement (CQI), Institute of higher learning (IHL)

ISSN: 0128-7702

INTRODUCTION

Optimising human and intellectual capital in engineering education is a continuous process and requires new inputs for improvement. This issue needs to be addressed and studied in detail. It requires a large sum of money, time and effort to come up with a systematic approach of engagement in any accreditation system. The additional workload and the burden of juggling between teaching-learning and administrative work could affect the productivity of academicians. There has always been a quality trade between teaching profession and the administrative tasks. From academicians' point of view, the focus should be on educating and producing qualified graduates for their future careers as demanded by the stakeholders. On the part of industry, management has the responsibility of supporting the delivery and assessment of engineering education. To maintain accreditation status is not easy. Motivational factors such as understanding the principles of engineering and its long-term benefits for organisation need to be documented and practised. Some of the benefits may include improvement in quality of graduates produced, raising university ranking and improving academic documentation, procedures and working instructions. The most important contribution is generating a perfect environment for work and clearly adopting the system guided by the vision and mission of the institution. With these moves, negative perception and de-motivation among members of the institution can be minimised, leading to a win-win situation among students, academicians and management teams. Several well-known engineering frameworks used for the higher education quality management system include ABET, CDIO, TQM, STEM and ISO.

Total Quality Management (TQM) is perhaps one of the well-known Japanese management process-approach philosophies applied in industry through mechanisms for continuous improvement of products and services. The philosophy fuels action to improve the outcomes of any customer's requirements, in this case, the quality of graduates. The idea of continuous improvement is the same approach for developing an academic quality management model. CDIO (Conceiving, Designing, Implementing and Operating) is another engineering education framework model focusing on a technical and knowledge-based approach. The main cycles involve Conceive-Design-Implement-Operate with continuous improvement to the work of producing quality and competent engineering graduates.

The Accreditation Board for Engineering Education and Technology (ABET) requires an outcome-based approach driven by a continuous assessment system for institutions of higher learning in their effort to produce quality graduates. This is also required for engineering programmes. A more recent approach, STEM education, focusses on

graduates with innovative and a wider scope of knowledge in areas of physical science, technology, engineering and mathematics. The academic management system is driven by multitasking, and therefore, tends to produce graduates with additional skills and capabilities. At worldwide level, the International Organisation for Standardisation (ISO) is a worldwide standard provider that offers quality management system for industry, technology, computing and communications. All of these management system approaches can serve as models for local, regional and foreign institutions of higher learning. A reliable academic management system will ensure that the requirements of both the Engineering Accreditation Council (EAC) and Malaysian Qualification Agency (MQA) are achieved. In time, a more stable and reliable academic quality management system model can be established.

LITERATURE REVIEW

The recent trend shows that the standard of engineering education falls short of expectation in achieving its learning objectives and outcomes. This has led to identifying three 'domains' of learning ability with the aim of achieving educational goals. The domains are the domains of cognitive, affective and psychomotor (Bettina Lankard, 1998) ability. One study classified student behaviour in terms of the intended outcomes of education (Krathwohl et al., 1964). Each domain contributes to specific areas of intelligence such as knowledge, skills and attributes. These outcomes are strong initiatives in overcoming the current shortage of qualified human capital, which has made the need for generating human and intelligent capital among engineering professionals essential (Rashid, 2012). MQA and EAC require all institutions of higher learning (IHL) to have an effective quality assurance system with an appropriate set of procedures (EAC, 2012). The MQA framework is benchmarked against that of developed countries such as England, Wales, North Ireland, Australia and New Zealand as well as certain countries in Europe. The emergence of Outcome-Based Education (OBE) is widely accepted as a replacement for result-based education for a more innovative and dynamic education system. Quality Assurance in higher learning currently places emphasis on output, that is, the quality of graduates in terms of academic results (learning) and employability or workplace recruitment is now the focus (Gray et al., 2009). This is a positive step as IHLs will be producing graduates who can meet stakeholders' demands. The shift from input-based to output-based education is expected to increase graduates' readiness and self-confidence to enter the engineering profession. This is how current engineering programmes are bringing progress to IHLs and their students (OBE Committee, 2012).

Each programme requires defined outcomes in producing graduates with certain skills and abilities to meet the needs of stakeholders (UNESCO, 2007).

The framework may include nurturing confidence and trust among stakeholders in maintaining quality and in meeting the criteria set for each engineering programme from certificate to doctorate level. The EAC manual promotes outcome-based education by incorporating the university engineering accreditation process with its vision and mission. Prime movers in the project will be the link between industry, IHLs, the government, the Education Ministry and recognised engineering standardisation bodies such as the Dublin Accord, Sydney Accord and European Accredited Engineer Project (Memon et al., 2009). Based on current demand, it is clear that engineering education needs to be reviewed and continuously upgraded from time to time. Results achieved can be evaluated to suit the requirements of IHLs. The success factors, according to the Washington Accord (WA), depend on planning, evaluation and improvement, and rely on a well-structured framework according to the latest global consortium for an accredited engineering degree programme (IEA, 2013). The accreditation agency for setting up the criteria in the United States is the Accreditation Board of Engineering and Technology, which is referred to on all matters related to engineering education (ABET, 2013). A holistic approach covering all processes in engineering education can help graduates excel and meet stakeholders' expectations (Kahveci et al., 2012).

The following are some views with regards to the advantages of implementing the right academic management model. Academic quality management system based on the ISO 9001:2008 can provide a foundation for total quality management and academic accreditation capable of meeting stakeholders' requirements (El-Morsy et al., 2014). There is evidence that students' satisfaction with academic performance was enhanced due to the implementation of the TQM model at the departmental level (Kosmidis et al., 2010). Applying CDIO, which stands for conceiving, designing, implementing and operating, has been proven to be effective in enhancing the engineering education model (Zhang & Liu, 2009). As for STEM, the interactive systems nature of its educational processes is unlikely to prove effective in improving undergraduate education (Porter et al., 2006). After reviewing the models, lack of organisation and quality was identified as the major failing. If this is strengthened, the proposed academic quality management system will work efficiently.

OBJECTIVES

The main objective of this study was to build an academic quality management system based on MQA and EAC requirements in nurturing future engineering professionals. Local Malaysian graduates are expected to master eight (8) domains listed in the Malaysian Qualification Framework (MQF) of learning outcomes. This includes Knowledge of discipline areas; Practical skills; Social skills and responsibilities; Values, attitudes and professionalism;

Communication, Leadership and team skills; Problem solving and scientific skills; and Information management and lifelong learning skills. All the domains are listed under MQA's requirements (Ministry of Higher Education, 2011). The EAC Manual 2012 has added several more domains for engineering graduates, including environment sustainability, project management and finance.

In order to achieve these outcomes, each university needs to prepare a strategic quality plan with a proper documentation system. The plan should be a benchmark for future engineering graduates of Malaysian IHLs in accordance with the Washington Accord.

METHODOLOGY

This study used standard engineering methodology by reviewing modules and framework available in the literature. A search was made for input from industry, students, parents, alumni as well as the government agencies through inputs and guidelines governing governmental ministries. Data gathered were used to determine and support elements in the proposed academic quality management system. Comparison with other quality management models were made on current trends and needs. Common concepts such as planning, organising, controlling and monitoring as well as continuous review were. This basic concepts came from TQM, ISO, CDIO, ABET and other quality management models.

Several criteria were used in comparing the academic management system used in Malaysian institutions offering engineering programmes. The EAC Manual uses six accreditation criteria as guidelines, namely, Academic Curriculum, Students, Academic and Support staff, Facilities and Quality Management Systems for qualifying requirements. MQA, which overviews overall quality assurances of Malaysian IHLs based on its code of practice of institutional audit (MQA & Malaysian Qualifications Agency, 2009), has nine qualifying requirements. The criteria were Vision, Mission, Education Goals and Learning Outcomes, Curriculum Design and Delivery, Student Assessment, Student Selection and Support Aervices, Academic Ataff, Educational Resources, Programme Monitoring and Review, Leadership, Governance and Administration and finally, Continual Quality Improvement. With the combination of both criteria, the foundation of developing a designated academic management model was set. Besides the EAC and MQA references, information from a Self-Assessment Report (SAR) submitted to the Board of Engineers Malaysia (BEM) for the purpose of applying engineering accreditation was referred to. These materials are classified as confidential and are prepared solely for accreditation purpose by each institution. Outcome-Based Education (OBE) also uses the continuous cycle of Plan-Do-Check-Action (PDCA) concept. This process-approach ensures that the model can be further improved

and enhanced throughout its process of improvement and that value-added activities are indeed beneficial.

Project Milestones

The project aimed to fully develop one reliable model of the academic quality management system. A few considerations were made to ensure the success of this academic quality management model:

- Evaluating the long-term and short-term goals of by alumni by assessing their PEO and PO
- Establishing and reviewing assessment processes by stakeholders
- Using reliable assessment tools in evaluating PEO and PO attainment
- Involving stakeholders and alumni in the teaching and learning process
- Promoting academic programme enhancement
- Motivating students and staff (academic and non-academic) in sustaining career development and academic programmes
- Monitoring the effectiveness of the current education system in teaching and learning (T&L) to produce competitive, competent and higher graduate employability
- Maintaining documentation and facilities such as safety, sufficiency and accuracy
- Planning a reliable academic Quality Management System and maintaining the institution quality standard

Planning

Planning is crucial to the process of developing an academic quality management model. Effective planning requires in-depth understanding and knowledge of engineering education requirements, which include basics such as criteria, core components, strategies and details of the project. Good understanding of guidelines, requirements and content for the accreditation is highly anticipated. Malaysian institutions offering engineering programmes need to meet all of the EAC and MQA's requirements. Some of the elements required for engineering accreditation can be applied, and many are compatible with quality management system standards. Below are three stages involved in developing the proposed academic quality management system:

(a) Establishment stage of reviewing the current system based on MQA/EAC requirements
(b) Assessment stage for system evaluation (PEO, PO, Academics, Student, Staff, QMS and OBE)
(c) Continuous Quality Improvement (CQI) stage to develop an academic Quality Management System

Establishment Stage

The establishment stage involves the formation of clear direction as to what were the objectives to be achieved by developing an academic quality management system model. The framework must comply with all the standards and legal requirements

and assessment criteria needed for the programmess. This includes the standards set by the Ministry of Education (MoE), Malaysian Qualifications Agency (MQA), Board of Engineers Malaysia (BEM), Engineering Accreditation Council (EAC) and other accreditation bodies. Knowledge of ISO standards such as 9001:2008 Quality Management System (QMS) can be an added value to the system. Apart from this, input from industry, represented by the Industrial Advisory Panel (IAP), the government and other interested stakeholders will also help. The achievement and outcomes produced should be aligned with the vision and mission of each IHL to ensure that credibility and the quality assurance system for academic achievement are established for a strong structure of setting up a reliable academic management system.

Assessment Stage

Once the structure is established, the implementation and assessment are necessary see how well the system is working. One method of ensuring the structure is working effectively is to test that the academic quality assurance system is per accreditation requirements. Auditing the system requires preparation and the readiness of the complete academic framework infrastructure before actual assessment; this includes documentation, personnel (student and staff), facilities and infrastructure as well as the whole academic curriculum structure of the Programme Educational Objectives (PEO), Programme Outcomes (PO), and Course Outcomes (CO). The academic quality management system should be established and implemented accordingly. This is important to ensure that achievement can be measured during the assessment stage. Assessment must be reliable and must reflect the students' actual performance to meet educational objectives and expected outcomes. There should also be clear evidence of outcomes obtained in fulfilling the assessment stage.

Continuous Quality Improvement Stage

After the system is assessed by accreditation bodies, the next stage focusses on all highlighted continuous quality improvement (CQI). The inputs received from the evaluators can be considered as improvement activities to enhance the institution's standard. Some critical input comes from assessment results, either direct and indirect or formative and summative). Input also comes from internal and external stakeholders, alumni and quality auditors. Any non-compliance is noted as an area for improvement. This auditing exercise provides room for improvements to the system. Improvement can be carried out either continually or continuously as recommended and decided by each institution. The closing loop process of the system will add value to the present academic quality management system. In the long run, the system will mature and contribute to the development of the academic quality management system.

Figure 1. Stages of the process of the academic management system.

RESULTS

Academic Quality Management System Structure

In developing the overall academic structure, the requirement elements must be structurally formed in order to complete the model. The standard for both MQA and EAC requirements can be aligned together to form one solid structure for the academic quality management system. This suggested model consists of six divisional structures embedded within four core structures, namely the Documentation System, Curriculum Structure, Quality Culture and Organisational Structure. The suggested model is illustrated in Figure 2.

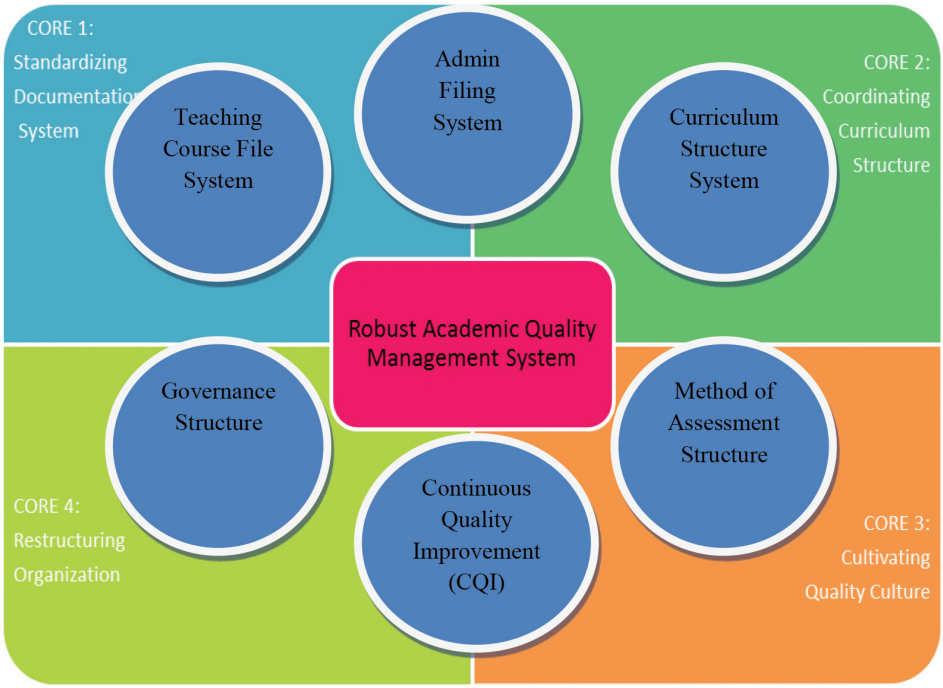

Figure 2. Formation of robust academic quality management system.

Documentation System Structure

A filing system for all the engineering programme courses needs to be developed and maintained from the beginning to the end of the evaluation period to monitor and evaluate the effectiveness of the teaching process. Each course file must be complete and the contents closely monitored by Quality Assurance Unit personnel. Files taken out must be returned to the filing cabinet each time to ensure availability to all. Lecturers must update the content of each file as this is considered an important document for auditing and accreditation purposes. Apart from the course file**,** laboratory files must also provide proper documentation as course supplement. These include documenting safety aspects in the laboratory and facilities infrastructure for supporting teaching and learning activities. On the larger documentation scale, such as for departmental and faculty level, a standardisation central documentation system is compulsory. Hundreds of documents need to be kept and properly segregated, indexed, categorised and arranged according to department.

The need to maintain a large number of official documents calls for a structured and well organised administrative filing system. One centrally controlled documentation unit headed by the Quality Assurance Unit can help to coordinate all the important documents for the whole faculty. The administration filing system can be colour-coded and arranged according to semester. This system will require good control and protection procedures to maintain content integrity of the whole academic quality management system.

Curriculum Structure

Curriculum structures deal with the formation of the engineering curriculum offered by the institution and the formation and establishment of an accredited engineering programme. The structure of the curriculum is a fundamental requirement for strengthening institutional reliability in producing graduates who meet the expectation of stakeholders. Curriculum structure must have objectives, direction and well-organised, correctly chosen programme education objectives (PEO). The structure is strengthened by linking the programme outcomes (PO) and executing the course outcomes (CO) through an efficient delivery process. For accreditational purposes, the new academic management system must include PEOs and POs that are developed based on the Washington Accord. A good educational objective utilises the SMART concept: systematic, measurable, achievable, reliable and timely. The PEO statement must be strongly connected with the mission and vision of the institution.

Method of assessment includes the process of evaluating and assessing the existing system. Indicators are used to measure either the results or outcomes to achieve objectives and targets set by the institution. Both PEOs and POs need to be measured to ensure that objectives and outcomes can be achieved

as evidence of the strategic plan and to strengthen the programme and graduate attainment. Therefore, the results of graduate attainment should reflect actual performance and should continuous strengthen the pillar attributes. Various assessment methods and tools are used to measure the attainment and performance of graduates. The most common method of assessment is to use direct and indirect measurements. These measurements can significantly determine if the education objectives and outcomes are met and fulfil the expectation of stakeholders. Some of the activities include internal assessment of the system and getting feedback internally and from the industry, alumni, students and other stakeholders. Loops in the system can be rectified by the process of improvement.

Other assessment methods may include benchmarking visits to other institutions, an accreditation visit and also meeting with the Industry Advisory Panel (IAP). Curriculum structure is meant to strengthen the pillars of the PEOs and ensure that graduate attributes are achievable by students enrolled in the programme. This includes all the different stages including educational objectives, programme outcomes and course outcomes. Such an effective system of student assessment can ensure that the quality of graduates meets the international standard and fulfils stakeholder needs.

To further improve any deficiency in the system, continuous quality improvement (CQI) can be applied to existing input to close any loops and to strengthen the existing curriculum structure. The morale of staff should also improve under the new system. In UKM, staff morale has improved tremendously since CQI was applied in teaching and learning activities. The positive result obtained can be seen in the improvement of staff working standard and academic management documentation, which must be continually dynamic and updated. Overall curriculum structure improvement can be seen in the documentation of all courses, departments and faculties. This is important as there are many documents to account for, from teaching and learning points to student performance documents such as quizzes, exams, projects, skills competency, industrial training and final-year projects, among others.

Quality Culture Structure

Developing a good working culture among students, lecturers and administrators at the workplace is not an easy task. It takes years to instil cultural acceptance in any organization, whether government or in the private sector. The same is true for institutions of higher learning. Several motivational techniques can be used to attract participation of employees in cultivating quality culture. Preparing for accreditation requires solid teamwork from all faculty members especially those serving on working committees. The workload and documentation preparation for compliance requires good planning and coordination in order to achieve satisfactory results. Internal audit is another example of

how departments work together to carry out audit activities among themselves as coordinated by the Quality Assurance Unit. In addition, laboratory audits are also carried out in compliance with the safety laboratory standard, including equipment testing and safe working procedures. Students are expected to follow laboratory guidelines and adhere to best practices in ensuring the laboratory is conducive and safe for use. Any non-compliance needs to be improved to ensure the laboratory meets all auditing requirements.

Self-assessment is another task carried out by the Faculty of Engineering and Built Environment (FEBE) every semester. The task can instil teamwork and quality culture among team members. The report reflects the enthusiasm among department members to carry out self-assessment for the betterment of documentation ownership. The culture of helping one another can produce best practices in a department. This activity also encourages team members to avoid any non-conformity while emphasising on quality awareness among members. In implementing such a system, the organisation must follow the department's standard operational procedure to avoid mistakes. Self-assessments prepare an institution for the actual audit exercise and provide confidence for the auditing committee through a self-assessment report prepared apart from the successful audit strategy. There are many other related activities that promote quality culture among workers, including providing research grants such as the Strategic Action Plan (PTS) funds and organising workshops and seminars to enhance the culture of conducting new, among others. To show the seriousness of embedded quality culture in UKM, an Engineering Quality Week was organised to disseminate information on accreditation to students and staff. Several Quality Awards were given away to best quality practitioners to honour their contributions to the faculty. Every year, UKM has organised *K-Novasi* for teaching and learning activities (T&L) to promote new techniques and innovation to enhance higher learning skills in education. There are many technical workshops being held throughout the year to cultivate quality culture in UKM.

Organisational Structure

Good structural organisation needs to have proper division with specific tasks and functions. An organisation must be driven by competent personnel within its organisational structure to ensure the goals of the institution can be achieved. Therefore, a solid governance structure is needed to ensure that the functions of the organisation can be smoothly ans systematically implemented, monitored, controlled and maintained for continuity of the structure. For efficient execution, selecting the correct administrative and management personnel, lecturers and support staff is important. They must be given suitable support to fulfil their tasks, duties and responsibilities. There should be clear expectations to ensure that the

entire academic quality system works well. Structured governance allows an institution to be organised and improves the quality of work of staff. A clear and strong structure also helps to develop better standard operation procedures and staff have a better understanding of what to do and how to do it. This is a valuable asset that strengthens the institution's position in supporting organisational structure. It is the duty of those holding leadership positions in the organisation to ensure that organisational structure is supported by competent persons. For accreditation purposes, department representatives can join the steering committee to help manage given tasks. The structure illustrated in Figure 3 shows how the QA organisational structure is set up with representatives from the Faculty of Engineering and Built Environment. The Head of Quality Assurance is supported by Science Officers and a secretariat for day-to-day operation of the unit.

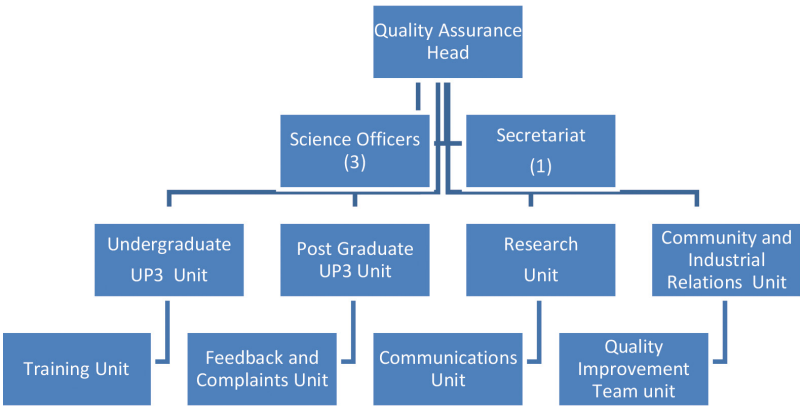

Figure 3. Organisational structure of a quality assurance unit.

The Quality Assurance Unit is restructured and expanded to cover all the tasks of the faculty. The governance structure is set up with a working committee with members from all the relevant departments. The working committee consists of four or five members led by a Department Representative, who is responsible for reporting the progress of the committee to the Quality Assurance Head. This consolidation group focusses on three main areas to achieve the UKM CITRA graduate attainment. The focus includes continuous quality improvement (CQI) and curriculum structure review based on PEO development and topics related to the improvement of quality services at faculty level. Focus on these areas brings greater impact to the overall curriculum with the establishment of comprehensive guidelines determining correct PEOs and POs. The Quality Management Committee structure representing the Faculty of Engineering and Built Environment (FEBE) is illustrated in Figure 4.

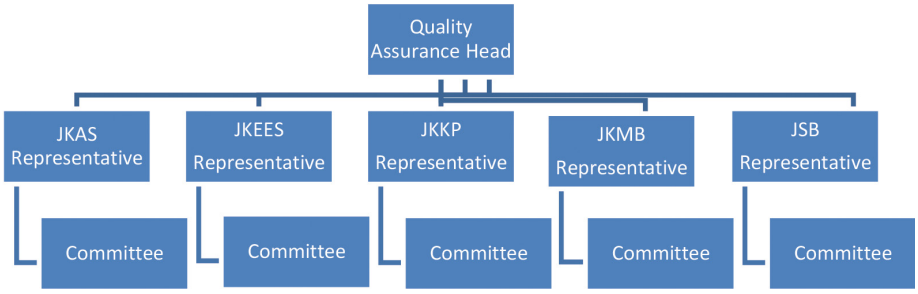

Figure 4. Quality management committee for FEBE accreditation task.

DISCUSSION

Research and Enhancement

The model presented was improved and contributed to some important engineering education feedback and valuable input. Self-healing and resolving CQI loop cycles can lead to changes that improve the level of engineering assessments and this is considered good practice. Lessons learnt from implementing this academic quality management system can be shared and can take the organisation to greater heights. The results correlate with and are reflected in the QS World University Ranking, the local university SETARA status and other higher educational evaluation and benchmarking. This helped to improve UKM's ranking among Malaysian universities as measured against University Malaya's (UM) ranking for engineering. This achievement can be used to help other universities. The quality of academic processes is continually being improved according to the needs of accreditation bodies as well as stakeholder requirements. UKM is distinguished as being a local IHL with accreditation status awarded by EAC for a full five years for its engineering programmes. Among others, Continuous Quality Improvement (CQI) is considered a very important element for an IHL to receive such an award as it makes the academic quality management system stronger and more reliable. Table 1 to Table 6 provide sample documents used by the Faculty of Engineering and Built Environment in UKM. These documents are prepared for supporting the faculty's academic quality management system. The strength of the system lies in the integration of all the six structures mentioned in this paper.

Table 1
Curriculum Structure Review Items

Structure Component	The important development
PEO	Correct method of PEO establishment
PO	Utilisation of standard attributes
Academic Curriculum	Mapping and actual assessment of formative and summative assessment
Student	Quality of graduate attainment /programme
Academic Staff	OBE implementation/motivation
Facilities	Sufficient and conducive environment
QMS	Develop, implement, monitor and improve

Table 2
Sample of Assessment Methods

Task	Related parties	Remark	Report
PEO assessment (Alumni and Employer)	Alumni Liaison Committee	Under Deputy Dean and P&A monitoring	PEO achievement report (alumni and employer)
PEO achievement analysis	Alumni Liaison Committee	Representative from each department	
PO assessment (Direct)	SP3P	PPA	Report analysis
PO achievement report (Direct)	UP3 Committee	Under Department Head and Deputy Dean P&A	PO achievement (Direct and Indirect)
PO assessment (Indirect)	SPPP	PJK	
PO achievement analysis (Indirect)	UP3 Committee	Under Department Head and Deputy Dean P&A monitoring	
Optimisation, PO mapping and determination of performance indicators	Programme Coordinator	Collaboration with UP3	External assessor report; Meeting with industrial panel; Benchmarking
Rubrics & formative assessment coordination	UP3 Committee	Members of UP3 Committee	
Summative assessment coordination	Chief Coordinator of Examination	Revised Bloom's Taxonomy	

Table 3
Sample of Continuous Quality Improvement (CQI)

Task	Activity	Frequency	Remarks
Review PEO and comprehensive programme and curriculum review	Input/Feedback from external assessors; Alumni survey; course review with industry; Benchmarking; Stakeholders' feedback	Every 3 to 5 years	Performance assessment and programme accreditation
PO assessment/ analysis of student attainment	Input from student exit and exam survey; Industrial Training/IAP	Yearly cycle	Reviewing programme/ student motivation
Course monitoring and assessment	Evaluate feedback from student/lecturer; Student assessment	Every semester, six-month cycle	Assessing delivery, teaching and facilities

Table 4
Sample of Administrative Filing System

No	File reference No.	File name
AUDIT - 13		
1.	ABC 1.18.4/13/x	Audit
POST GRADUATE - 105 (By Course)		
1.	ABC 1.18.4/105/x	Examination
2.	ABC 1.18.4/105/x	Examiner Committee Meeting (viva)
3.	ABC 1.18.4/105/x	Masters of Engineering Programme
COMMITTEE MEETING - 111		
1.	ABC 1.18.4/111/x	FKAB Curriculum Committee Meeting (Faculty Course Review Workshop; PEO & PO)
2.	ABC 1.18.4/111/x	Departmental Curriculum Committee Meeting (Curriculum Review Workshop)
3.	ABC 1.18.4/111/x	Accreditation Committee Meeting (Alumni Relations Committee; Benchmarking Committee; Curriculum Review Committee; Organising Committee with Industry Committee)
4.	ABC 1.18.4/111/x	Materials related to accreditation (Meeting with IAP, industry & alumni; External examiner report; Benchmarking report, etc.)
5.	ABC 1.18.4/111/x	Quality Assurance Division Committee Meeting (QAD)
6.	ABC 1.18.4/111/x	UP3 (Teaching, Improvement and Learning Units) (PO analysis achievement; PEO analysis achievement)
7.	ABC 1.18.4/111/x	CQI (Continuous quality improvement) (Course and programme improvement level, Form B1)

Table 5
Sample of Teaching File Management Label, Forms and Checklists

No.	Department	Filing label by colour
1	All Engineering Faculty	White (Semester 1) + Light purple (Semester 2)
2	Chemical/Process Engineering	Light green (Semester 1) + Dark green (Semester 2)
3	Electrical/Electronics and System Engineering	Yellow (Semester 1) + Orange (Semester 2)
4	Mechanical/Materials Engineering	Light blue (Semester 1) + Dark blue (Semester 2)
5	Civil/Environmental Engineering	Pink (Semester 1) + Red (Semester 2)
6	Built Environment	Light brown (Semester 1) + Dark brown (Semester 2)

TABLE 5 (continue)

Form & Checklists	Purpose
Teaching Folder Checklist (Under graduates course)	Undergraduate course assessment
Teaching Folder Checklist (Post graduates course)	Postgraduate course assessment
Follow Up Form Courses Teaching and Learning Improvement (B1)	Form used to receive feeedback for postgraduate programme
Feedback to Teaching and Supervision Evaluation System (*SPPP*)	Feedback and complaint on teaching courses (Improvement from previous semester)
Mark Distribution Form	Confirmation form between the performa and the achievement mark

Table 6
Quality Assurance Governance Structure

Key Personnel	Task/Function
1. Dean of Engineering Faculty	QA Decision maker
2. Head of Quality Assurance	Coordinate Faculty and QA activities
3. Secretariat / Science Officers	Assisting QA Head in QA activities
Main division Unit	Sub-Units
UP3 Undergraduate Unit UP3 Post Graduates Unit Research Unit Community & Industry Relations Unit	Training Unit Feedback and Complaints Unit Communication Unit QIT Unit
4. Departmental Representative(s) - Civil/Environmental Engineering Dept (JKAS) - Electrical/Electronics/System and Engineering Dept (JKEES) - Chemical/Process Engineering Dept (JKKP) - Mechanical/Materials Engineering Dept (JKBM) - Built Environment Dept (JSB)	Executing all QA function for Faculty of Engineering & Built Environment (FEBE)

CONCLUSION

On a wider scale, any engineering faculty can be managed more economically from an administrative point of view. This includes reducing unnecessary documentation and additional workload among lecturers. It would be beneficial for other IHLs to implement a similar system for evaluating the academic quality management system of their engineering programmes. Engineering education is a continuous process and there is no limit to outperforming others in terms of developing a better system. This new academic quality management system model allows for structured and manageable preparation for the accreditation process for engineering. The model can assist other IHLs in their

own best practices. Perhaps one of the challenges faced by an institution would be how to make an academic quality management system part of their work culture. Strong and committed leadership can raise the level of engineering education and transform it into a holistic experience for students and at the same time, take it to international standards. In the coming years, engineering education is set to reach greater heights by producing intellectual capital adequately prepared to enter the job market, confident of meeting stakeholders' expectations. A proper academic quality management system (AQMS) allows more engineering graduates to be fully equipped for their future profession. This will in fact open the horizon for realising Malaysia's vision of becoming a fully developed nation with high income for citizens by 2020.

ACKNOWLEDGEMENT

We would like to thank the Faculty of Engineering and Built Environment, UKM Bangi, Selangor, Malaysia for their supported grant PTS-2014-020 for selecting and financing the article to be published in this reputable journal.

REFERENCES

ABET. (2013). Criteria for accrediting engineering programs 2014-2015. *Cycle*, 25. Retrieved from http://www.abet.org/Linked Documents-UPDATE/Criteria and PP/C001 08-09 CAC Criteria 11-8-07.pdf

Brown, B. L. (1998). *Applying constructivism in vocational and career education*. *ERIC clearinghouse on adult career and vocational education* (Vol. No 378). Retrieved from http://www.amazon.com/dp/0582280109

El-Morsy, A., Shafeek, H., Alshehri, A., & Gutub, S. A. (2014). Implementation of Quality Management System by Utilizing ISO 9001: 2008 Model in the Emerging Faculties. *Life Science Journal, 11*(8), 119-125. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-84899833187&partnerID=tZOtx3y1

Engineering Program Accreditation Manual. (2012). Engineering Accreditation Council. *Engineering Program Accreditation Manual.* Retrieved September 17, 2013, from www.eac.org.my/web/document/EACManual2012.pdf

Gray, P. J., Patil, A., & Codner, G. (2009). The background of quality assurance in higher education and engineering education. In *Engineering Education Quality Assurance* (pp. 3–25). Springer US. Retrieved from http://dx.doi.org/10.1007/978-1-4419-0555-0_1

IEA. (2013). Graduate attributes and professional competencies. *International Engineering Alliance*.

Kahveci, T. C., Uygun, Ö., Yurtsever, U., & İlyas, S. (2012). Quality assurance in higher education institutions using strategic information systems. *Procedia – Social and Behavioral Sciences*, *55*, 161–167. http://doi.org/10.1016/j.sbspro.2012.09.490

Kosmidis, K., Chatzis, V., Stavropoulos, A., & Terzidis, K. (2010). Incorporating TQM in higher education: Students' assessment of academic performance. *MIBES Transactions*, *4*(1), 152–164.

Krathwohl, D., Bloom, B., & Masia, B. (1964). *Taxonomy of educational objectives: The classification of educational goals - Handbook II: Affective domain*. David McKay Company. Retrieved from http://scholar.google.co.uk/scholar?start=0&q=bloom+krathwohl&hl=en&lr=lang _en&as_sdt=0,5#8

Memon, J. A., Demirdöğen, R. E., Chowdhry, B. S., Demirdöğen, R. E., & Chowdhry, B. S. (2009). Achievements, outcomes and proposal for global accreditation of engineering education in developing countries. *Procedia – Social and Behavioral Sciences*, *1*(1), 2557–2561. http://doi.org/http://dx.doi.org/10.1016/j.sbspro.2009.01.451

Ministry of Higher Education. (2011). *Malaysian Qualifications Framework*. Ministry of Higher Education, MQA.

MQA, & Malaysian Qualifications Agency, M. (2009). *Code of practice for institutional audit (COPIA)*. *MQA*. Malaysia: MQA.

OBE Committee. (2014). *OBE implementation guidebook*. FKEE, Universiti THO.

Porter, A. L., Roessner, J. D., Oliver, S., & Johnson, D. (2006). A systems model of innovation processes in university STEM education. *Journal of Engineering Education*, *95*(1), 13–24. http://doi.org/10.1002/j.2168-9830.2006.tb00874.x

Rashid, M. H. (2012). *The process of outcome-based education – Implementation, assessment and evaluation.* Malaysia: Penerbit UITM Press.

UNESCO. (2007). Quality assurance and accreditation: *A glossary of basic terms and definitions.* Buchares:. Washington Accord. (2007). Retrieved form http://www.ieagreements.org/Washington-Accord/signatories.cfm

Zhang, Y.F., & Liu, J. (2009). An experiment of computer curriculum reform based on CDIO in engineering education. In *Computer Science & Education, 2009. ICCSE'09. 4th International Conference* (pp. 1629-1632). IEEE. http://doi.org/10.1109/ICCSE.2009.5228314