

Addressing the Issues and Challenges in Ensuring Quality Engineering Graduates Using the Outcome Based Approach (OBA): The UTM Experience

*Shahrin Mohammad, Azraai Kassim and Khairiyah Mohd-Yusof
Universiti Teknologi Malaysia*

Abstract

Universiti Teknologi Malaysia (UTM), being the largest producer of engineering graduates in Malaysia, is firm in its effort to ensure the continuance of excellence to produce quality graduates. UTM engineering graduates are not only sought by local and multinational industries, but they are also successful in pursuing post-graduate studies locally or abroad. Currently UTM offers 28 undergraduate and 47 postgraduate engineering programmes, making it one of the top universities in Malaysia offering engineering programmes. As part of the commitment to excellence, UTM continues to enhance the graduates using the outcome-based approach (OBA). This paper describes the insight into the experiences of implementing the outcome-based approach in teaching and learning at UTM. The issues and challenges in ensuring quality engineering graduates will also be elaborated. Finally, this paper makes some recommendations on how the outcome-based approach can be carried out to ensure further improvement on the quality of the graduates.

Introduction

OBA, introduced by William Spady (Spady, 1993), is designed based on a triangle of knowledge, competence, and orientation. It focuses on outcomes in the preparation of graduates for the work place. It is a process that involves the restructuring of curriculum, assessment and reporting practices in education to reflect the achievement of high order learning and mastery rather than just the accumulation of course credits (Tucker, 2004). In other words, it focuses on what the student should be able to do or achieve upon graduation by providing learning and teaching activities to help them reach such level, followed by assessing to what extent they have attained the outcomes. This approach monitors students' performance today, by projecting their competencies as an engineer of tomorrow through continuous quality improvement (CQI). OBA will facilitate the desired changes within learners, by increasing knowledge, developing skills and attitudes. In OBA, the best way to learn is to first determine what needs to be achieved. Once it has been determined, the strategies, processes, techniques, and other ways and means to achieve the outcomes that are required are developed. At the end, these require documented evidences which demonstrate the graduates' achievements.

OBA has been adopted as the international standard for many engineering accreditation professional bodies. The Washington Accord, which binds together professional engineering accreditation bodies of more than 13 countries such as United Kingdom, United States, Canada, Australia, Ireland, New Zealand, Japan, and South Korea, is one such example that requires the adoption of OBA. As a member of the Washington Accord (WA) since June 2009, the Engineering Accreditation Council (EAC), Board of Engineering Malaysia (BEM), made OBA a requirement for accreditation for engineering

programmes in Malaysia. The achievement of being a member of the WA has demonstrated a genuine shift within the engineering education system in Malaysia from the conventional-based system towards the outcome-based approach system.

At the national level, the Malaysian Qualification Agency (MQA), which is responsible for ensuring the Malaysian Qualification Framework (MQF), has also placed the OBA to be implemented in all academic programmes. All academic programmes must specify the learning outcomes based on MQF and from other regulatory bodies, deliver and make the necessary assessment activities in ensuring the required achievement levels.

UTM as Malaysia's premier university in engineering and technology is continuously stepping up efforts to improve its engineering programmes to meet the aspirations of the nation to produce quality graduates that focusses on the outcome-based education approach. In December 2005, while Malaysia was a provisional member of the Washington Accord, twenty one (21) of the engineering programmes at UTM had undergone the accreditation exercise based on the outcome-based approach and manage to secure a full five years accreditation status. Consequently in July 2009, just after Malaysia joins the Washington Accord, UTM engineering programmes had undergone another accreditation exercise. And recently the efforts pay off as all the 28 engineering undergraduate programmes obtained accreditation.

The implication of implementing OBA in teaching and learning at the institutional level is the key to the success. UTM's serious efforts towards the outcome-based approach by implementing OBA started as early as 2002 when awareness seminars were conducted in various the faculties. An example of efforts to promote innovative teaching and learning methods in UTM can be seen in Mohd-Yusof et al. (2005).

OBA at UTM

Attempts to improve the competencies of the students in many aspects are actually neither new nor rare. In doing so, many engineering academic staff has consciously or subconsciously applied several approaches in their teaching and learning. UTM embarked on this approach based on the conviction that the efforts will really benefit the students and our desire to always continually improve our engineering programmes.

UTM employs a comprehensive approach, combining technical competencies and generic skills sought by employers as early as 2002. Since then, UTM has embarked on numerous activities pertaining to OBA. These activities had been perceived by the academic staff as a lot of activities in isolation until all these bits and pieces are put together into one picture known as the UTM OBA conceptual model shown in Figure 1.

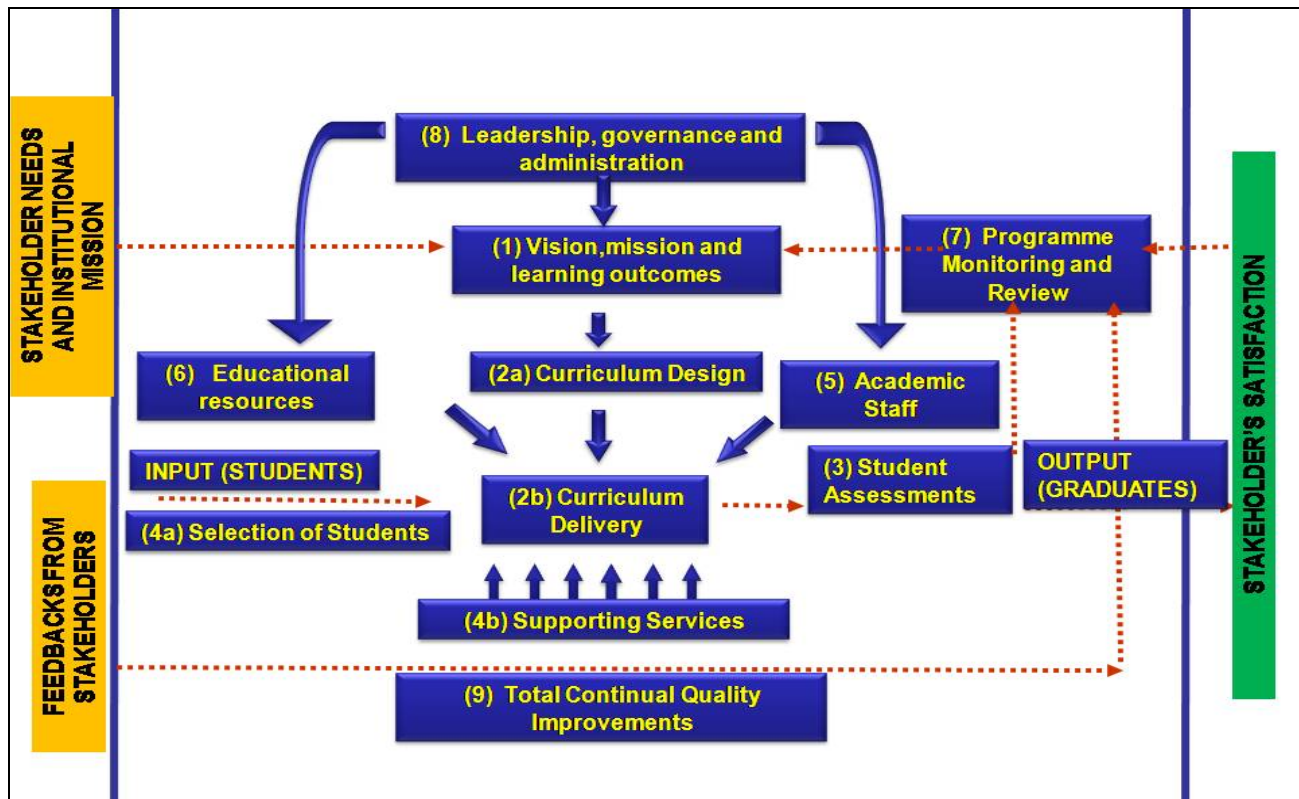


Figure 1: UTM OBA conceptual model

In relation to OBA, the present set up of UTM leadership, governance and administration ensures the consistency of policies and practices are in place in the three main areas below:

i. Vision, Mission and Learning Outcomes

The top management has set a clear vision, mission and educational goals. The vision, mission and educational goals becomes the direction and operational framework in the development of three levels of learning outcomes that is the programme educational objectives (PEO), programme outcomes (PO) and course outcomes (CO) and are developed together with the stakeholders. Apart from the stakeholder's requirements, the UTM Graduate Attributes which outlines seven graduate attributes also form the basis in the development of the PEO, PO and CO. All the efforts are driven by the Deputy Vice-

Chancellor (Academic & International) with the assistance of the staff from the Centre for Teaching and Learning (CTL), the Undergraduate Office and the Academic Quality Unit (AQU).

ii. Providing adequate educational resources

The top management is responsible for providing adequate educational resources as it provide a conducive ecosystem for learning and teaching. It includes the adequacy of physical facilities, equipment, information and communication as well as library services. The use of e-learning as a means to help student learning is very much encouraged by the top management. This area is also concerned with the adequacy of human resources and financial allocation. The practice of providing adequate resources are governed by the respective code of practices such as Code of Practice (CoP) for Teaching and Learning

Resources, CoP for Teaching and Learning Infrastructure, Equipments and Environment and CoP for e-Learning.

iii. Ensuring quality and competent academic staff

UTM has a clear policy of recruiting quality academic staff where the criteria are based on academic merit. The CTL also plays a proactive and important role to equip the existing academic staff with adequate training and tools to improve teaching and learning activities. Various forms of training related to higher education are available through the CTL, supported by the Human Resource Development division. Several approaches are taken to ensure that the academic staff has essential knowledge and skills. For new academic staff, they all have to undergo the Higher Education Teaching Certificate Programme. Other academic staff are required to attend the competency courses based on the Competency Level Evaluation (PTK) Scheme, which they need to pass for promotional purposes. Regular training programmes are also provided in the form of workshops and courses on topics ranging from Academic Advising, English for Content Area Instructors, Web-based Design for Teaching, E-learning, various teaching methodologies, and many others. In addition, conferences on Engineering Education were held since 2004, where knowledge, good practices and research outputs in engineering education can be shared. Experts in engineering education, such as Professor Richard Felder and Dr. Rebecca Brent, Professor Karl Smith, Professor David Radcliffe, Professor Anette Kolmos and many more were invited to give courses, seminars and keynote addresses.

Once the learning outcomes for a particular programmes has been established, a curriculum is designed focussing on what the student should be able to attain at the end of the teaching and learning process. These have been documented in the Programme Specifications and/or Course Outlines. The three levels of learning outcomes (PEO, PO and CO) must address the adequate level of breadth and the depth of the programme as stipulated in the Code of Practice for Programme Accreditation (2009) and the Engineering Accreditation Council, Manual (2012). Mapping between the CO-PO-PEO is done to ensure the three levels of learning outcomes are in line with one another. The mapping between the CO and the three domains of educational goals i.e. the cognitive, psychomotor and affective together with the levels is also carried out. In addition to these mappings, another mapping between the CO and soft skills also being addressed. All these documents are checked and verified at various committees and finally approved by

the Department of Higher Education, Ministry of Higher Education.

The programme specification is provided to all new students as the main reference for their study in UTM. The programme specification clearly indicates the intended PEO and PO of the programme. It clearly describes the technical and generic skills expected and the expected professional knowledge, skills and attitudes during future employment. It also indicates the various teaching and learning methods and the assessment methods adopted for the programme. The specification also shows the programme structure which includes features, curriculum and award requirements.

The next line of action is to ensure what has been documented is put to practice. The outcomes, delivery methods and assessment should be aligned (Felder and Brent, 2003). The delivery methods are realigned to support students to attain the learning outcomes. Various teaching and learning deliveries such as problem-based learning, active learning, cooperative learning, project-based learning, laboratory work, field work, industrial training, e-learning and research-based training are introduced and is detailed in the CoP for Design and Curriculum Development as well as the CoP for Teaching and Learning Methods. Academic staff need to be competent in handling the teaching and learning techniques as well as the supervisory skill, and is assessed continuously through the Lecturers Teaching Assessment (e-PPP) surveys and Competency Level Assessment (PTK). The Office of Undergraduate Studies and the School of Graduate Studies are the entities that monitor the standard and quality in all aspects of teaching and learning activities being practiced.

The student assessment stage is the process that determines the level of the student achievement. Assessment will drive students to learn. In OBA, the entire curriculum is driven by assessments that focus on well-defined learning outcomes in which the academic staff will use various teaching and learning approaches to help students to achieve the outcomes. Given that assessments in OBA focus on the students' learning outcomes, both at the programme and course level, it has always been the difficult stage to implement. Hence, developing an assessment plan at the appropriate level is of prime importance. It is very important to strategize the assessment activities so that it is manageable, not overburdening the staff but yet giving reliable and valid results.

In designing the plan, the following points have to be considered:

1. The purpose of the assessment; either to;
 - a. assess individual students by the academic staff for learning (the formative approach) or to grade their performance (the summative approach) at course level

- b. assess group of students by the academic staff for course improvement (formative)
 - c. assess group of students by the academic staff for overall programme improvement (summative)
 - d. assess individual students by themselves (self-assessment or self-reflection) or by the academic advisor (formative and/or summative)
 - e. assess group of students by the stakeholders through surveys, interviews for programme improvement and evaluation (formative and summative).
2. Clear, specific and measureable learning outcomes.
- a. Clear teaching and learning approaches as well as the strategies to achieve these learning outcomes must be emphasized.
 - b. Assessment methods and processes adopted to determine the level of the students achievement must be determined. The issues of who should do, when, how should we gather and process the data is very important. For each outcome, an overall timeline for the assessment plan including the person responsible must be specified.
 - c. Once the data has been gathered, it need to be analysed and based on the findings, decisions, plans and recommendations for further actions are necessary for continuous improvement.

Having these in mind, two ways for assessing students' learning had been proposed:

- i. Staff assessment on students performance based on the course outcomes either through the in-class or out-of-class activities such as exams, assignments, design projects in courses, professional practices project , co-curriculum activities and final year project corresponding to the program outcomes. This is known as the "course contribution toward the programme outcomes". In doing this, the purpose of assessment mentioned in 1(a-c) above will be covered. At the end of each semester, the academic staff, not only present the usual marks and grades, but also present the reports based on all the specified outcomes. This report is known as the Course Assessment Report (CAR).
- ii. Students, faculty and stakeholders assessment on the overall student performance. Suggested assessment tools to assess the student learning and evaluate the programmes are;
 - a. Entry and exit student survey
 - b. Students Portfolio

- c. Examination Results
- d. External examiners
- e. External advisors
- f. Survey from industries
- g. Graduate survey

Data gathered is analyzed and will be utilized to monitor and to review the programme. Based on the findings, further decisions, plans and recommendations are made for continuous improvement. In this way, further improvement in the area of teaching and learning, the delivery techniques, resources that need upgrading, management support, staff competence and other deficiencies can be worked out. All the evidences are recorded in the Programme Assessment Report (PAR).

All the above processes are illustrated in Figure 2 and Figure 3 and are known as the UTM Continuous Quality Improvement (CQI) model showing compliance to the EAC-BEM CQI requirement. This model has been used to facilitate the planning, implementation, checking and further action to be conducted for self review. This is done regularly every semester to check on the academic performance of students and programs. It is now normal practice for faculty to report on the following output parameters through the PRR.

Issues and Challenges

The implementation of OBA is not a straight forward process. There are issues and challenges in implementing OBA at the institutional level. Since there are more than 200 programmes offered, initially, it took some time and efforts to develop, define and communicate well-defined learning outcomes, i.e the PEO, PO and CO as we are used to write the objectives of the courses instead of learning outcomes. It is very difficult to come out with clear documentations to be communicated to all staff. It needs time and effort to come out with new documentation or to realign the existing one. Up to now, most programmes documented have undergone at least two cycles of CQI on documentation.

Even with proper documentation, to get the commitment of the staff who are already used to the traditional-approach is another issue. Thus, there is the need to carefully prepare them by giving awareness and understanding on the need for a major culture change in the engineering education system which focuses on CQI. This culture change will inevitably contribute significantly towards strengthening the quality of the graduates. Awareness programmes are focused on the best way of implementing the OBA with minimum effort but giving effective results.

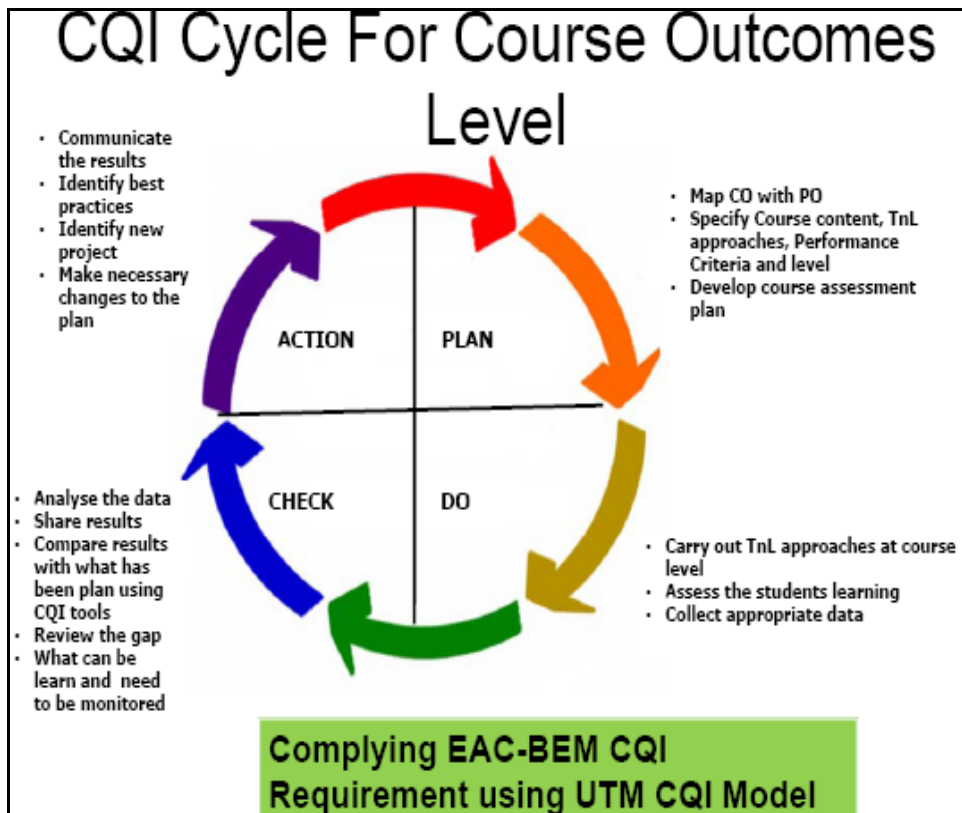


Figure 2: Compliance of EAC-BEM CQI Model for PEO's and PO's

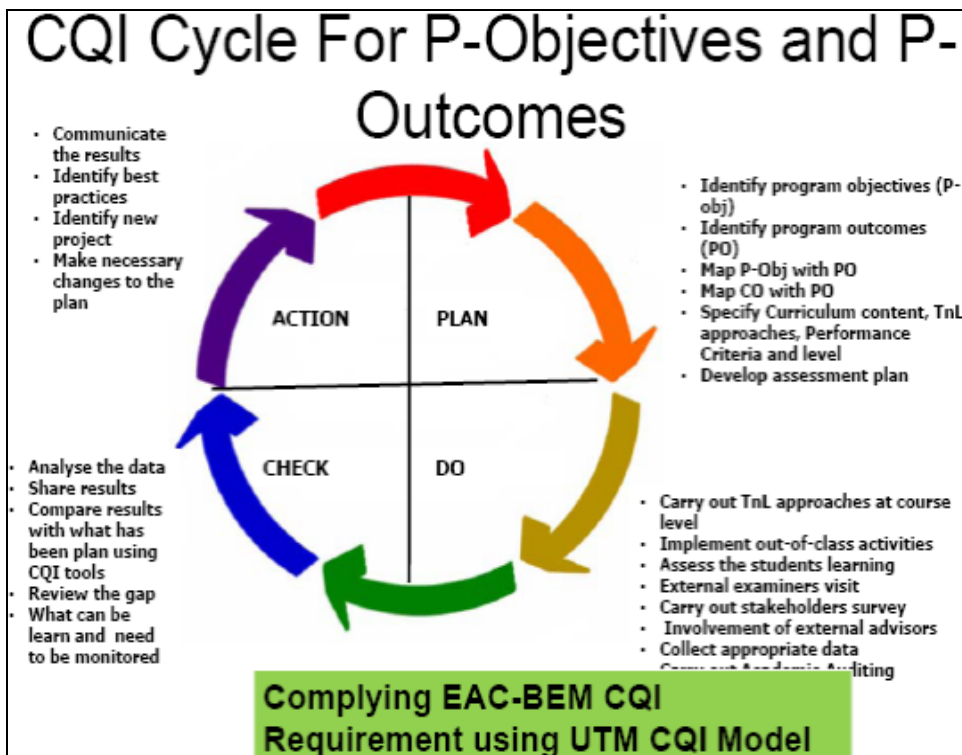


Figure 3: Compliance of EAC-BEM CQI Model for Course Outcomes

Another main issue is on how to measure the effectiveness of the PEO and PO objectively. Various assessment methods to assess the PEO, PO and CO are adopted. This requires a well-deliberated assessment plan. Too many methods and too frequent assessment could overburden the academic staff. The validity and reliability of the assessment methods is also an issue. Among the most challenging aspect in assessment is the need for appropriate assessment method, and the need to adopt qualitative assessment methods for certain skills or submissions such as reports, presentations, etc. In OBA, it is crucial for assessment and evaluation to be meaningful so that the appropriate action can be taken. Consequently, UTM carried the second cycle on developing the assessment plan and has come up with the CAR and PAR as mentioned above.

It is anticipated that monitoring, tracking, documenting, evaluating and reviewing all the activities involved in the OBA is a big challenge specifically to academic administrators. The main challenge is whether we can maintain it throughout given the situation that most academic administrators in public institutions of higher learning adopted the two to three years rotational system.

Recommendations for Future Improvement

As discussed earlier, the main concern is on the effectiveness of the approach in giving a significant impact on the graduates so that they can enter successfully the competitive employment market. The top management of the higher education providers should offer great support at all levels in the planning, implementation and assessment stages. The top management should remain focused in discussing on the best way of implementing OBA. Support such as sufficient resources in terms of facilities need to be addressed and should link funds or budget with the OBA plan. As for an example, information need to be communicated clearly and effectively to all levels via all means. Utilising problem-based learning requires adequate facilities and proper training for academic staff for facilitating students to involve actively in discussion and presentations. Up-to-date facilities on information and communication technology are of prime importance if students are to utilise the e-learning approach effectively.

The important role contributed by the academic staff in delivering the courses need to be encouraged by giving incentives such as training, providing technological tools to reduce and ease them in assessing, collecting and analysing the outcomes as well as giving a clear indication in the promotion exercises. Converting to OBA from the traditional one is essentially a change management process. Hence, the basic principles of change management should be

applied. The academic supporting units that include the academic and technical officers should not be neglected and must provide them with a clear direction on how to operationalise the OBA. As an indispensable part of quality assurance, self-assessment of the academic staff urges them to reflect on their activities, achievements and performances with the aim of facilitating improvement or planned change. It is acknowledged that the Teaching Portfolio will enable academic staff to document the quality of their teaching and to reflect on their teaching in ways that can lead to the enhancement of teaching. The Teaching Portfolio can contribute to an increase in professional accountability as it puts faculty in charge of monitoring, improving on, and ensuring the quality of teaching.

The role of students in OBA is also important. After all, they are the ones that require such outcomes in order to enter the job market successfully. Therefore, by utilising Student Portfolios created by the students themselves and the application of self-assessment tools are highly recommended. They must also show full commitment and participation for developing the outcomes for the good cause and benefit of themselves.

As far as assessment is concerned, several approaches are required to give a better representation of student performance. However, a proper and strategized assessment plan is deemed necessary to avoid too many activities that could overburden everybody. Existing data should be fully utilized and modifications made where necessary. Clear, measurable and realistic targets need to be set to enable progress to be measured and assessed. Another way to assess the impact of OBA is through proper feedback from the industries using quality surveys and questionnaires which are very much desired for continual improvement and development.

OBA requires total support and commitment from all levels to succeed. Teamwork is absolutely critical. This is easy to talk about but not necessarily easy to achieve. In the overall development of outcomes, it requires full cooperation, participation and partnership between the students, learning providers and the industries. A better mechanism of communication should also be provided and enhanced.

Since many higher education providers have adopted a quality system in managing academic programmes such as ISO 9001:2000 or other standards promoted by professional bodies, synergising all the requirements using a unified model is suggested to avoid duplication of work. As a matter of fact, there are many things in common to all the standards.

Another important ingredient of success in OBA is the culture of continuous quality improvement (CQI). Indeed, CQI has entered the world of higher education

with controversy. There is the need to have a paradigm shift to focus on customers, improve processes, clarify vision and mission, organise around teams, and manage by data. It seems that most of our administrative functions are compartmentalised and our academic activities are somewhat disconnected. CQI offers the opportunity to look at the process systematically, to know and align them and at the same time, simplify our processes. A CQI model based on the PDCA cycle is suggested and shown diagrammatically in Figures 2 and 3. In order to evaluate the whole cycle, an academic audit to help the higher educational provider to continuously improve is also highly recommended.

Concluding Remarks

The changing character of higher education has a great impact on us. With the changing demands from the society, changing needs from the stakeholders/customers and changing focus to the outcome-based approach, demands on OBA approaches to educational planning, delivery, and assessment methods is to be expected. OBA has been mandated and has the potential to deliver a high level of learning for students as it facilitates the achievement of the outcomes. The very least we can do is to do our best in order to ensure it is implemented properly. This paper has outlined how OBA can be smartly implemented. The issues and challenges in the implementation are elaborated. Finally, this paper has recommended on how outcome-based approach can be carried out to ensure further improvement on the quality of the graduates.

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