EVALUATION OF PROGRAMME EDUCATIONAL OBJECTIVES FOR CIVIL ENGINEERING TECHNOLOGY PROGRAMME WITH WORK-BASED LEARNING APPROACH

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Abstract: Politeknik Ungku Omar (PUO) offers an undergraduate degree programme in Civil Engineering Technology with Work-Based Learning (WBL) approach in 2013. The Bachelor of Civil Engineering Technology (BCT) programme is considered as the pioneer engineering degree programme in Malaysia to implement this collaborative approach with the industry. This study is to evaluate BCT graduates' career progression, and hence the achievement of the Programme Educational Objectives (PEOs) which are monitored by indirect assessments through surveys to the alumni and employers, as well as the WBL participating companies. The scores used for the surveys are on a scale of 1 to 4, with 1 being poor and 4 being outstanding. The results for PEOs from the surveys indicated ratings between 3 and 4. This is an indication that the PEOs specified for the programme have been achieved. Generally, and overall, the WBL in the BCT programme are found to be effective in enhancing the programme's relevance for industry, as well as the graduates' career progression.

Keywords: *Programme Educational Objectives, Bachelor of Civil Engineering Technology Programme; Work-Based Learning*

1. Introduction

The rapid and continuous development of international engagement among higher education institutions (HEIs) had encouraged the HEIs to offer a more competitive and internationally recognised programmes. Furthermore, interrelated factors such as stakeholders demand for profitable and sustainable academic programmes, institutional recognition and industry demand had also influenced the HEI efforts (Basir et al., 2019). Thus, in line with the Ministry of Higher Education of Malaysia's Polytechnics Transformation Road Map 2010 - 2020, Politeknik Ungku Omar (PUO) was given the task to offer a hands-on degree programme in Civil Engineering Technology with Work-Based Learning (WBL) approach starting September 2013. This programme called Bachelor of Civil Engineering Technology with Honours (BCT) is considered as the pioneering undergraduate engineering programme in Malaysia to implement a collaborative approach with the industries through Work-Based Learning. BCT programme offered by PUO emphasizes on the building of a strong foundation in civil engineering fundamentals, the application of technology to reach sustainability and an understanding of the principles of project management and finance. The Civil Engineering Technology degree programme is structured to be more practical based than the conventional science-based Civil Engineering degree programme. In order to keep abreast with the rapid

technological advancements and evolving requirements in industries today, students will undergo two semesters of experiential learning by a structured on-the-job-training or Work-Based Learning (WBL) with the nation's key industry players.

The competitiveness demands to raise the academic standards has brought on the system of Outcome-based Education (OBE) to be the most accepted approach in higher education where decisions about the curriculum are driven by the outcomes the students should display by the end of the courses (Nakkeeran et al., 2018; Asim et al., 2021). It is based on professional knowledge, skills, abilities, values and attitudes rather than on the educational process (Hussain et al., 2021). With the increasingly global marketplace for higher education, OBE has been adopted at a fast pace in engineering education programmes to ensure the degrees granted to students are competitive and accredited internationally, and the graduates are competent in practicing engineering (Davis et al., 2006). One of the first elements that are required to be developed in the implementation of OBE is the Programme Educational Objectives (PEOs). PEOs are a set of specific goals or targets which describe the expected achievement of graduates in their career and professional life a few years after graduation (Faiz & Almutairi, 2021). These specific goals must be aligned with the vision and mission of the academic institution and are defined in collaboration with the relevant stakeholders to the programme (Zaitseva & Quadrado, 2019). Students, alumni, staff, community groups, industry partners, and professions (employers) as well as the government are the stakeholders in higher education.

The PEOs of BCT programme are in accordance with the polytechnic's transformation agenda to produce knowledgeable, highly skilled, and competent human capital to drive the knowledge and skills-based economy as required by the developed countries. The PEOs are determined by incorporating the vision and mission of the Department of Polytechnic and Community College Education (DPCCE) and Politeknik Ungku Omar (PUO) as well as the stakeholders' expectations. All the stakeholders had been involved through varied degree of participation in the development and review process of the PEOs. Stakeholders' participation is often through the attendance of meetings, workshops, questionnaire surveys, focus group dialogues or forums to ensure that the programme objectives are consistent with the institution's vision and mission (Fitzpatrick et al., 2009; Pramono et al., 2020). Throughout the processes, the feedbacks, comments, and recommendations from the various stakeholders were solicited and consolidated. The process of reviewing and revising the PEOs requires two types of stakeholder feedbacks which are the stakeholders-initiated input and alumni attainment assessment. Stakeholders initiated input occurs when there is a need for change triggered by any of the major stakeholders. The major stakeholders for BCT programme are the Ministry of Higher Education (MOHE) and the industries.

Therefore, the objectives of this study are to assess the PEOs attainment from stakeholders' feedbacks which are the alumni and employers. The study offers some important insights into the continuous quality improvement process of BCT programme.

2. Background of Study

The PEOs are initially formulated with reference to the guidelines produced by the Malaysian Qualifications Agency (MQA) and the Board of Engineers Malaysia's (BEM) Engineering Technology Programme Accreditation Standard (ETAC). Realising the needs and requirements of the stakeholders, BCT programme have underlined long-term objectives to be achieved by graduates within 3 to 5 years upon graduation. The PEOs statements for BCT are as follows:

PEO1: *Become technically competent Civil Engineering Technologists and engaged responsibly in activities in line with the technological challenges of civil engineering industrial development.*

PEO2: *Be committed to practice Civil Engineering Technology and act on the basis of professional conduct to promote sustainable development for the advancement of society and nation.*

At the institutional level, the Academic Council will monitor the attainments of PEO of the programmes offered. According to (Zaitseva & Quadrado, 2019)(Chan et al., 2020), the council is responsible to continuously improve the PEO instruments by:

i. coordinating the item of PEO achievement instrument
ii. obtaining the information of alumni; distribute and collect the PEO instrument from the alumni
iii. analysing the PEO data findings
iv. producing a research report on PEO achievement
v. keeping the research report for audit purposes
vi. managing curriculum quality improvement process

The council holds meetings to discuss and decide the matters pertaining to PEOs within the institution. Figure 1 shows the implementation of PEO achievement research and the use of its findings to improve BCT programme.

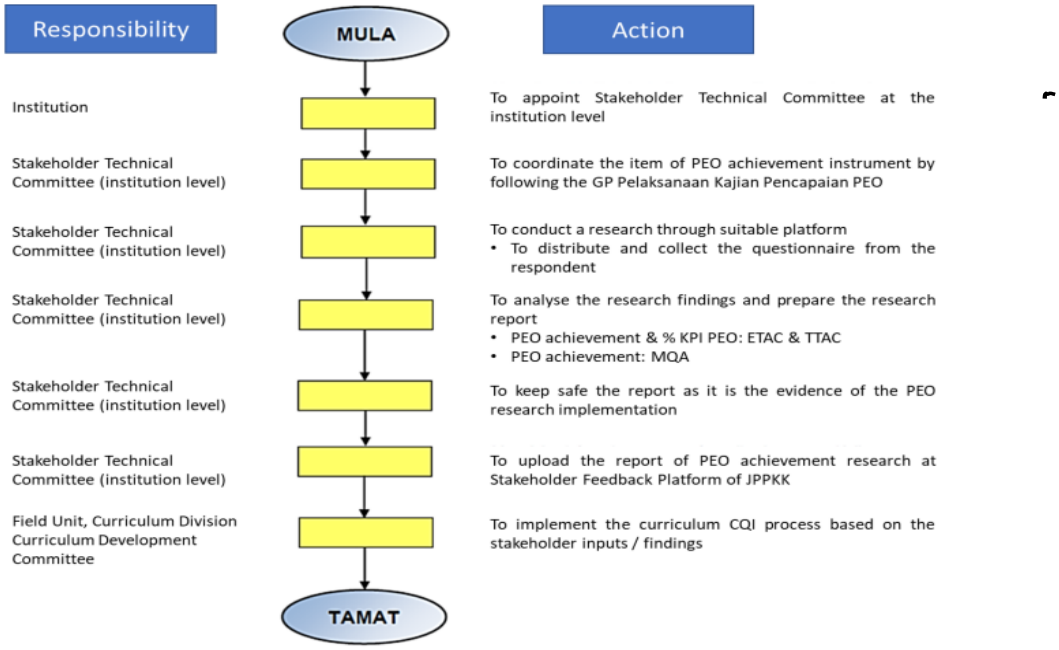

Figure 1. Flowchart of the Implementation of PEO Achievement Research and the Use of Its Findings as Programme Improvement

3. Methodology

This section explains the methodology and research strategy used to collect opinions from a target audience through a questionnaire survey. Descriptive analysis was used to analyse the data. PEOs are directly assessed through the questionnaires distributed to the employers and alumni. Until November 2020, there were about 254 total graduates from the five cohorts of BCT programme, with the first cohort (2013 intake) graduated in year 2016 as presented in Figure 2. Since the performance of PEOs that will be considered are for graduates with 3 to 5 years of working experience after graduation, thus data from the 1st, 2nd, and 3rd cohorts of BCT students that graduated in year 2016, 2017 and 2018, respectively are considered for the evaluation of the PEOs achievement. In total, there are about 80 graduates or alumni who are expected to have working experience in the engineering field and all the graduates have responded to the survey. The Performance Indicators (PI) of each PEO are provided as the achievement criteria with a target performance in percentage.

In addition to conducting surveys on alumni, surveys were also conducted to the companies that employed the graduates of cohort 1, cohort 2 and cohort 3. The objective of the survey was to obtain the employers' opinion regarding the quality of graduates. Among a list of 50 possible contacts, 36 responded to the survey. The sample consisted of a variety of companies including contractors, developers, and engineering consulting firms. Most of the companies have experience in managing BCT students during their participation in the WBL stint.

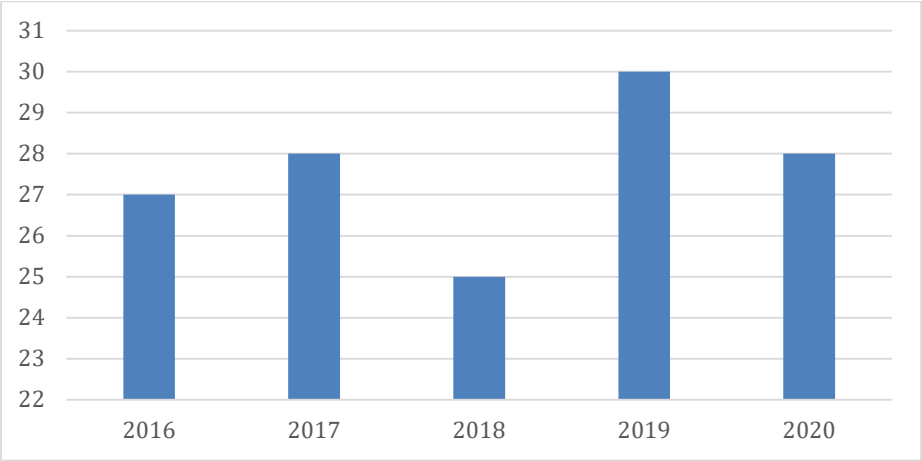

Figure 2. Number of BCT graduates for five cohorts

4. Findings and Discussion

4.1 Respondents' Agreement on PEO 1: Become technically competent Civil Engineering Technologists and engaged responsibly in activities in line with the technological challenges of civil engineering industrial development.

The indicators to measure the success of BCT programme in preparing graduates to become technically competent Civil Engineering Technologists and engaged responsibly in activities in line with the technological challenges of civil engineering industrial development were evaluated. Based on the collected data as shown in Table 1, the achievement of the PEOs were based on the key performance indicator for the 1st, 2nd and 3rd cohorts of BCT graduates. Overall, the percentage achievement has met the indicator which is more than the expectation. It is found that 74% (cohort 1), 89% (cohort 2) and 88% (cohort 3) of the graduates are employed in the professional engineering technologist related industries.

Figure 3 showed that the highest professional engineering technologist career are those who work as site engineers (cohort 1 and cohort 3) and civil engineering technologist (cohort 2). The findings in 'others' also indicates 26% (cohort 1) graduates work in non-engineering technology field and the percent was reduced to 11% and 12 % for cohort 2 and cohort 3, respectively. From the employment point of view (Figure 4), about 23% (cohort 1) of the graduates are now working with government sector, 29% (cohort 2) working with multi-national companies (MNC) and 36% (cohort 3) of the graduates are now working with small and medium enterprises (SME). This survey proves that the programme designed has successfully groomed them for better employability and have high competency in professional engineering technology field.

Figure 5 illustrates the distribution of multi-disciplinary project involved by the BCT graduates, which include management, architecture, electrical, mechanical, quantity surveyor and IT fields. The results indicate the strength of PEO 1, in which the programme has successfully produced professional technically competent civil engineering technologists working not only at national but also at international levels in line with the technological challenges of civil engineering industrial development.

Table 1. PEOs Indicators and Achievement as Perceived by Alumni

Performance Indicators	**Score**		
PEO 1	**1st Cohort**	**2ndCohort**	**3rdCohort**
1. Working towards a professional engineering technologist (70%)	74%	89%	88%
2. A team member in a multi-disciplinary project (50%)	84%	98%	95%
PEO 2	**1st Cohort**	**2ndCohort**	**3rdCohort**
1. Involvement in Civil Engineering Technology professional development activity/courses (50%)	63%	64%	63%
2. Participated in activities organised by learned societies or community service organisations (10%)	11%	32%	12%

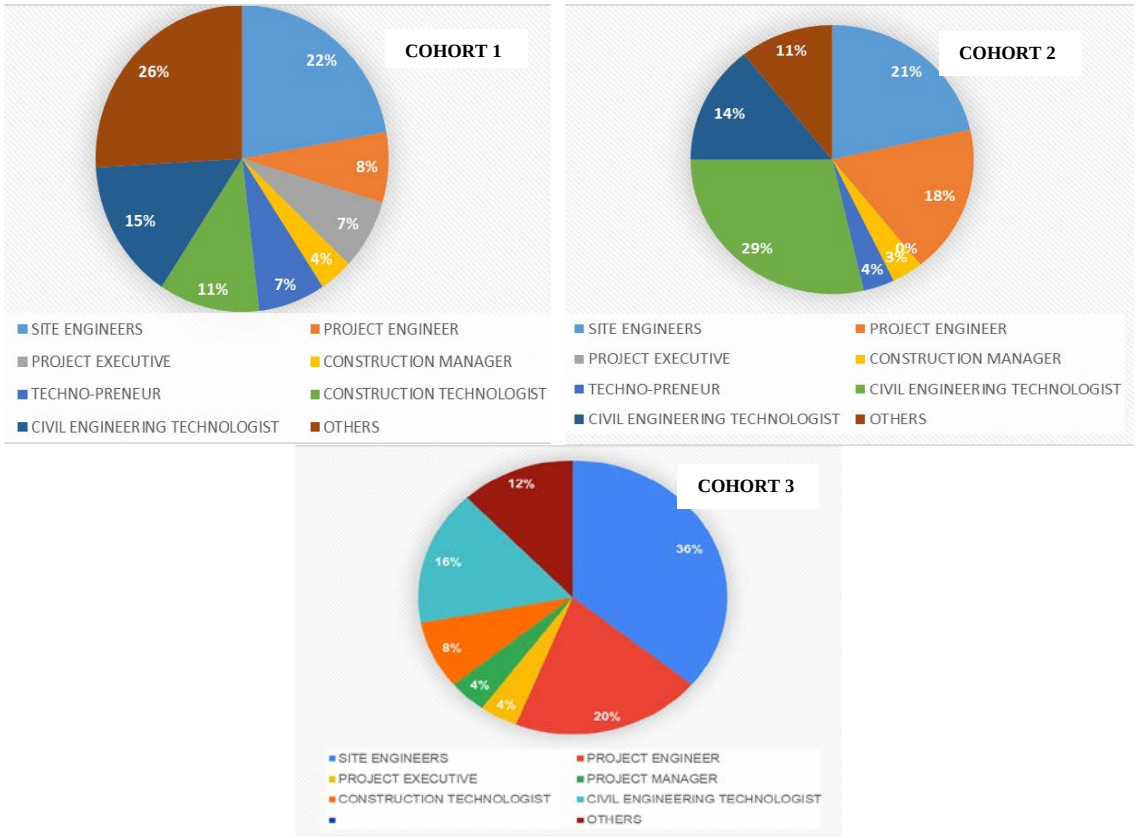

Figure 3. Working towards a professional engineering technologist

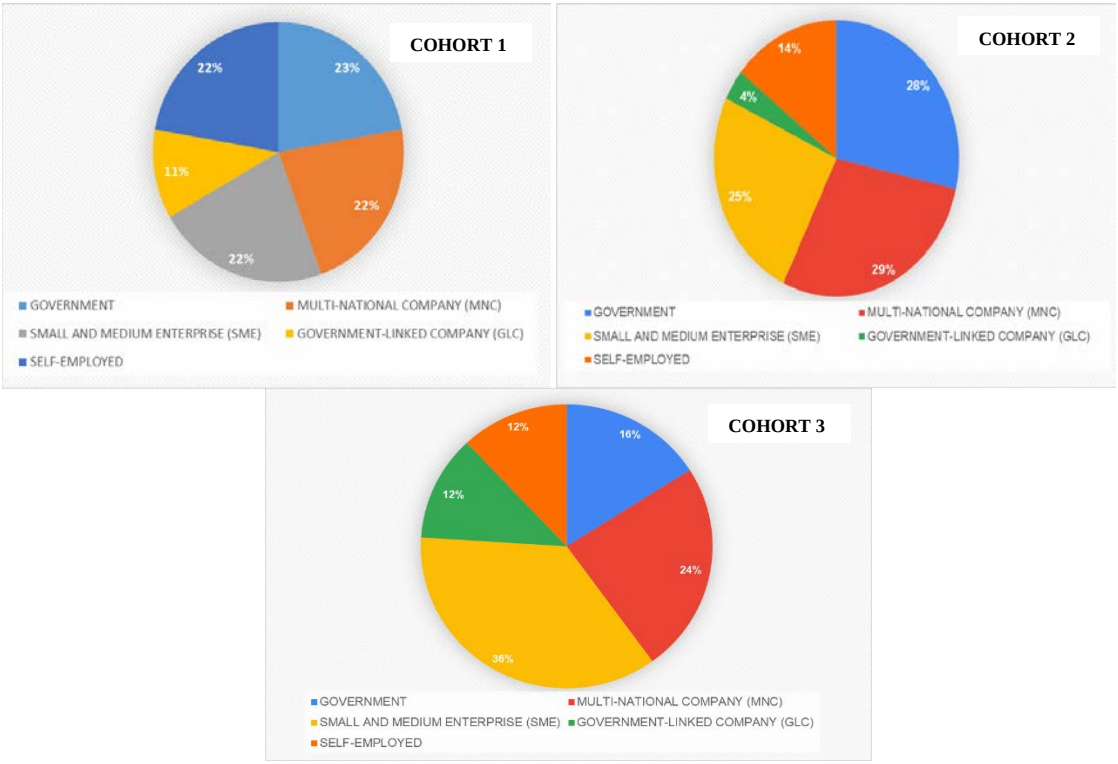

Figure 4. Types of organisation involved

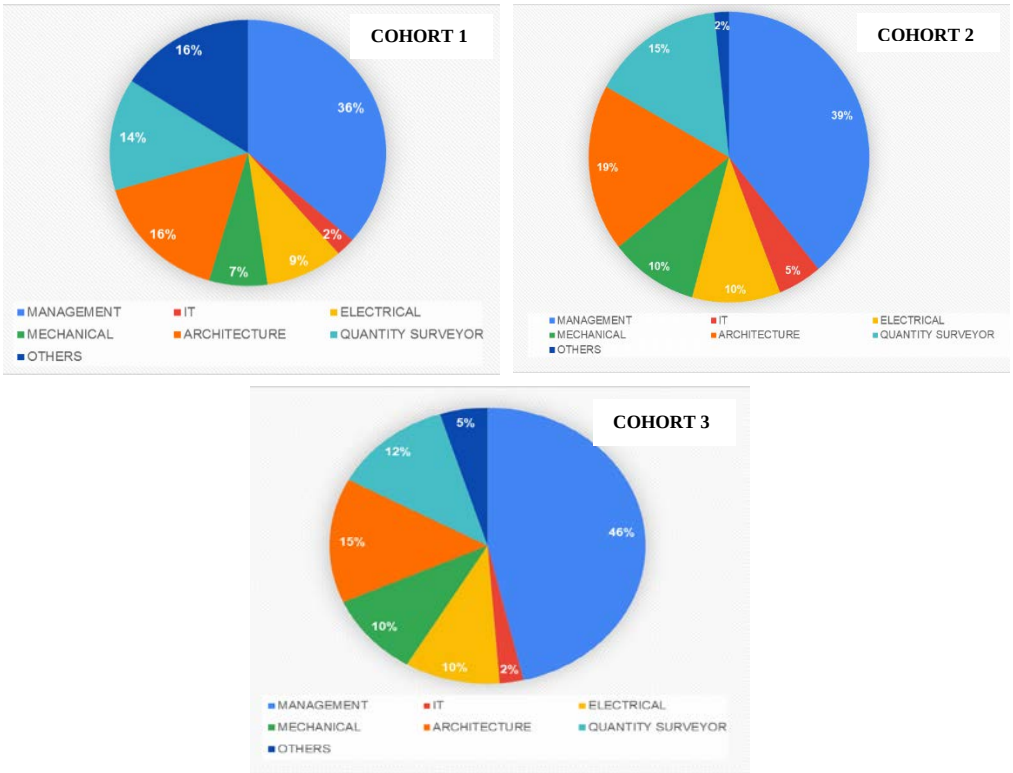

Figure 5. A team member in a multi-disciplinary project

4.2 Respondents' Agreement on PEO 2: Be committed to practice Civil Engineering Technology and act on the basis of professional conduct to promote sustainable development for the advancement of society and nation.

There are 2 indicators designed to address PEO 2 which include the involvement of Civil Engineering Technology professional development activities/courses as well as participation in social responsibility activities. The scorings based on these indicators are higher than the minimum target (Table 2). The findings also indicate 63% (cohort 1), 64% (cohort 2) and 63% (cohort 3) of the graduates have attended Civil Engineering Technology professional development activities/courses such as workshop, seminar, course, conference, talk, training, project site visit, study visit, technical visit, annual general meeting and others (Figure 6).

In addition, Table 2 also shows, about 11% (cohort 1), 32% (cohort 2) and 12% (cohort 3) of the graduates shared their social responsibility through engagement with the community service organisations. Although their involvement in community services organisation are just above the minimum target, nonetheless, there are still room for improvement. It is an essential skill which must be acquired by the graduates during their career life. It is heartening to find out the graduates are aware of their responsibilities to the professional development towards advancement of the society and nation, which attributed to the success of PEO 2.

Table 2. PEOs Indicators and Achievement as Perceived by Alumni

PEO 2: Performance Indicators	Score		
	1st Cohort	2nd Cohort	3rd Cohort
1. Involvement in Civil Engineering Technology professional development activity/courses (50%)	63%	64%	63%
2. Participated in activities organised by learned societies or community service organisations (10%)	11%	32%	12%

4.3 Employer Survey

The achievement of PEO 1 is evaluated through several attributes namely knowledge in civil engineering technology, technical competency, critical thinking, communication skills, and practical skills. The achievement of PEO 2 is evaluated through several attributes namely problem solving, professionalism and ethical responsibility, self-learning and motivation, entrepreneurship and leadership. The results of the survey indicated that the employers are satisfied with the graduates. All respondents rated the quality of BCT graduates as above the average with a rating of 3 to 4, on a scale of 1 to 4, with 1 being poor and 4 being outstanding. The survey results are shown in Table 3.

Table 3. PEOs Indicators and Achievement as Perceived by Employers

Performance Indicators	**Score/Rating**		
PEO 1	**1st Cohort**	**2ndCohort**	**3rdCohort**
1. Knowledge in Civil Engineering Technolog			
2. Technical competency			
3. Critical Thinking	3.29	3.50	3.43
4. Communication Skills			
5. Practical Skills			
PEO 2	**1st Cohort**	**2ndCohort**	**3rdCohort**
1. Problem solving			
2. Professionalism & ethical responsibility			
3. Self-learning and motivation	3.57	3.67	3.71
4. Entrepreneurship			
5. Leadership			

5. Conclusion

Findings from the study on employers supported the findings of the PEOs achievement as perceived by the alumni. Both findings indicate that PEOs performance is at a good level. This is an indication that the PEOs specified for the programme have been achieved. PEOs attainment results have been presented in meetings with the academic management council of PUO, and the Industrial Advisory Panels (IAP) of BCT programme. Feedbacks, comments, and suggestions are gathered to be used for BCT's Continuous Quality Improvements (CQI). Based on these feedbacks, the BCT programme would be able to determine whether the strategies adopted by BCT in fulfilling the requirements of the regulators (e.g. BEM-ETAC) and keeping up with the current needs of the industry are on the right track and producing the right results. The curriculum structure of BCT programme includes courses supporting the attainment of the Programme Learning Outcomes (PLO) of students upon graduation to achieve the PEOs while working in the civil engineering technology field. Table 4 outlines the CQI strategies with action plans. The PEOs attainments have been analysed to drive the continual improvement for ETAC curriculum implementation.

Table 4. PEOs Attainment and Initiatives for Continuous Quality Improvement

Findings from PEOs attainment	**Actions/Activities for Continuous Quality Improvement**
Students need to improve in technical competencies (PEO1)	1. Encourage participation in national competitions. 2. Industrial linkage activities must be frequently conducted to expose students to the actual practice in civil engineering. 3. Enhance industry experts' involvement in teaching, learning and assessment activities.
Students need to improve on professional activities and engagement with the community (PEO 2)	1. Enhance sharing sessions with successful professional engineers. 2. Encourage more social activities and engagement with the communities. 3. Enhance participation of students in community-industrial engagements.

To date, all the initiatives for continuous quality improvement for BCT programme have been implemented for the following cohorts of students in order to enhance the quality of learning and teaching environment, and thus, improving the achievement of PEOs.

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