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# A CASE STUDY OF IMPROVED PEO ASSESSMENTS IN THE ELECTRICAL, ELECTRONIC AND SYSTEMS ENGINEERING PROGRAM AT UNIVERSITI KEBANGSAAN MALAYSIA

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**Abstract**

Program educational objectives (PEOs) encompass a collection of statements that outline the knowledge, proficiencies, and competencies that graduates of a program should possess. PEO assessments are conducted for the purpose of evaluating the degree to which students have attained these objectives. However, the current assessment methods are not comprehensive and do not provide sufficient data to determine whether graduates are achieving the intended outcomes of the program. As a result, the program may not have sufficient data to provide informed decisions about curriculum development and student support services. This study provides an examination of the recently implemented Program Educational Objectives (PEO) evaluations within the undergraduate program of Electrical, Electronic and Systems Engineering, at the Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia (UKM). This study examines the difficulties encountered during the development and execution of direct and indirect PEO evaluations, along with the measures undertaken to enhance these assessments. It also includes a quantitative analysis of the findings generated from the newly implemented PEO assessment questionnaires. The study concludes by providing a discussion of the advantages associated with enhancing PEO assessments, as well as the potential usage for other engineering programs within the faculty.
*Keywords*: Direct assessment; graduate assessment; indirect assessment; programme educational objectives; quantitative analysis

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**Abstrak**

Objektif pendidikan program (PEO) ialah satu set pernyataan yang menerangkan pengetahuan, kemahiran dan kebolehan yang perlu dimiliki oleh graduan sesuatu program. Penilaian PEO dilakukan untuk mengukur pencapaian pelajar terhadap objektif ini. Walau bagaimanapun, kaedah penilaian semasa tidak menyeluruh dan tidak menyediakan data yang mencukupi untuk menentukan sama ada graduan mencapai hasil program yang dihasratkan. Akibatnya, program mungkin tidak mempunyai data yang mencukupi untuk menyediakan keputusan termaklum tentang pembangunan kurikulum dan perkhidmatan sokongan pelajar. Kajian ini membentangkan penilaian PEO baharu yang dilaksanakan dalam program Sarjana Muda Kejuruteraan Elektrik, Elektronik dan Sistem, di Fakulti Kejuruteraan dan Alam Bina, Universiti Kebangsaan Malaysia (UKM). Kajian ini membincangkan cabaran yang dihadapi dalam membangunkan dan melaksanakan penilaian PEO secara langsung dan tidak langsung, serta langkah-langkah yang telah diambil untuk menambah baik penilaian ini. Ia juga membentangkan analisis keputusan yang diperoleh daripada soal selidik penilaian PEO baharu. Kajian ini disimpulkan dengan membincangkan faedah menambah baik penilaian PEO, serta potensi untuk digunapakai dalam program kejuruteraan lain di fakulti.

*Kata kunci*: Pengukuran langsung; penilaian siswazah; pengukuran tidak langsung; objektif pembelajaran program; analisis kuantitatif

## 1.0 INTRODUCTION

Education plays a significant role in fostering the growth of both social and economic capital. The presence of creativity and innovation is a source of inspiration, while preparing youths with essential skills to effectively participate in the global labour market. Additionally, it serves as a significant catalyst for economic progress. In October 2011, the Malaysian Ministry of Education launched a comprehensive review of the education system to develop a new National Education Blueprint 2013-2025 (MOE, 2015). It proposes an outcome-based education (OBE) approach, where every education program is linked to specific student outcome targets. In accordance with the reform policy established by the ministry and the Malaysian Quality Assurance of Higher Education framework, the implementation of Outcome-Based Education (OBE) has been initiated and assessed in many academic disciplines, including sciences and technology, social sciences, and humanities, across multiple universities in Malaysia (Eng, Akir & Malie, 2012; Tan et al. 2018).

The Board of Engineers Malaysia (BEM, n.d.) has adopted the OBE as the main criterion for evaluating engineering programmes offered by the institutes of higher learning

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(IHLs). A robust educational framework and a methodical approach are required for engineering programs to be successful (Shivakumar et al. 2015). One of the crucial components within the OBE criteria is the Program Educational Objectives (PEOs).

The PEOs outline the anticipated attributes of engineering graduates following a period of three to five years after the completion of their educational program at the institution of higher learning (BEM, n.d.). The curriculum of the department is meticulously crafted in accordance with the PEOs to cultivate and generate graduates who possess a comprehensive understanding of fundamental and contemporary knowledge, skills, and values. This educational approach aims to equip students with the necessary competencies to excel as engineers. The Program Educational Objectives (PEOs) have been developed in conformity with the faculty and university's vision and mission, while also considering the demands of the stakeholders.

UKM presents a set of strategic measures that can be implemented to enhance its ranking in accordance with the Six Key Achievements (KRA, 2018). UKM has consistently made efforts to enhance its ranking by utilising several criteria and their corresponding indicators. One of the primary objectives of KRA is to cultivate graduates who exhibit national aspirations, competency, competitiveness, and innovation capabilities, as defined in the first KRA statement (KRA1).

The assessment methods for course outcomes and program outcomes have been discussed (Mohamed, Taib & Reza, 2010; Mokhtar, Puteh & Anuar, 2014). Abdullah (2009) proposed a method for the continual review of the objectives and outcomes in engineering programmes based on the OBE evaluation. The evaluation is conducted through surveys administered to stakeholders, such as engineering companies and organisations in Malaysia, with a focus on potential employers of the alumni graduates. Meanwhile, a comprehensive comparative analysis has been published on PEOs for graduates in the field of Electrical and Electronic Engineering in Malaysia (Ab-Rahman et al. 2022). Typically, the assessment of PEO attainment is retrieved from survey responses based on the performance and perception of alumni and employers (Miller, 2013; Salim et al. 2022). However, there is a need for improvement in the program's current assessment method and analysis. The current assessment methods do not fully capture the achievement of PEOs, which could impact decisions about curriculum development and student support services.

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This paper focuses on enhancing the assessment of PEO by utilising a revised set of questionnaires administered to alumni and employers, who constitute the primary stakeholders of the PEOs. The process of establishing the appropriate domains to meet both internal and external needs is a meticulous endeavour that necessitates concentrated effort from multiple parties. The rest of the paper is structured as follows: Section 2 presents the methodology used in this study, comprising two main categories of direct and indirect assessments. Section 3 presents the quantitative analysis and discussion of the survey results. Finally, Section 4 concludes the study.

## 2.0 MATERIALS AND METHODS

Direct and indirect measurements are two of the most fundamental concepts in measuring PEO achievements. Direct measurements are those in which the quantity to be measured is measured directly, without the need for any intermediate calculations. Indirect measurements, on the other hand, require the measurement of one or more other quantities, from which the quantity of interest is then calculated (Brown, 2022).

The PEOs represent a collection of long-term goals that outline the desired attributes and accomplishments that graduates of the Department of Electrical, Electronic and Systems Engineering (JKEES) are meant to achieve within a timeframe of three to five years following their graduation. The temporal parameters within which the anticipated attainment of the PEOs play a crucial role in the assessment and examination of the PEO's fulfilment. However, the PEO committee at the department has identified several weaknesses in the previously utilised questionnaires. These weaknesses include alumni survey questions that are unrelated to PEO statements, and questions that attempt to combine multiple attributes into a single evaluation. These issues have resulted in difficulties in outcomes measurement and have rendered the questionnaires ineffective for measuring the attainment of PEOs. Furthermore, the employer questionnaire used data from industrial training surveys. This is inaccurate to measure PEO attainment because the employer was evaluating the performance of third-year students undergoing industrial training, rather than alumni graduates.

Hence, the department's PEO committee has organised a workshop to enhance the PEOs measurement method on March 22nd, 2023. The session invited a distinguished speaker from the Faculty of Social Sciences and Humanities (FSSK), UKM. Two sets of new questionnaires were devised, namely the alumni survey and the employer survey. The structure of the new alumni survey was divided into direct assessments and indirect

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assessments. Meanwhile, the new employer survey focuses on indirect assessments that are correlated with the alumni survey, to measure the perception of employers against the perception of the alumni graduates. A five-point Likert-scales question was used to rate the agreement of alumni and employer respondents to statements related to the PEO performance indicators. Table 1 displays the measurement criteria and performance indicators for the revised PEOs surveys. These details have been derived from the outcomes of the workshop and have been subjected to additional feedback from various stakeholders, including alumni and the Industrial Advisory Panel (IAP).

In addition, technology has been employed to enhance the efficiency and efficacy of PEO assessment disbursement. This has been achieved through the utilisation of various tools, including Microsoft Forms, Google Forms, and automated personalised bulk messaging API. The API enables customised dissemination of messages to respondents through the implementation of Visual Basic Codes and Whatsapp Web (Respond.io, n.d.). The applicability of addressing the issues and reaping the advantages of enhancing PEO assessments can be extended to other engineering programmes within the faculty. By adhering to the aforementioned procedures, alternative engineering programmes can enhance their PEO evaluation methodology and ensure that their students graduate with the necessary knowledge and competencies required for success in their professional careers (Jones, Smith & Williams, 2019).

Table 1. PEOs measurement performance criteria and performance indicators

| **Programme Educational Objective (PEO)** | **Performance Criteria** | **Target (Direct indicators)** | **Target (Indirect indicators)** |
|---|---|---|---|
| **PEO 1:** An engineer who has **character** and **ethics**, as well as high **professionalism** and contributes to the **National Aspirations** | Graduates with national identity and proud to be Malaysian.<br>● Ability to use the Malay and English language in performing verbal and written tasks.<br>● Willing to work in a government-linked company (GLC)/ government sector.<br>● Ability to apply and practise his/her understanding of | ● 10% of alumni working in the GLC/government sector<br>● 50% of alumni have good/above average communication skills in Malay Language in career tasks | ● 50% of alumni and employers rate the application of ethical values in the career as Good/Outstanding<br>● 50% of alumni and employers rate professionalism attitude in the career as Good/Outstanding<br>● 50% of alumni and employers rate appreciation of national aspirations in the career as Good/Outstanding |

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| | professional and ethical responsibility when dealing with environmental and contemporary issues. | | ● 50% of alumni and employers rate career achievements towards the development of the nation according to the national culture as Good/Outstanding |
| **PEO 2:** An engineer who is **competent** in respective engineering practices that meets current and future needs. | Graduates show that their professional enhancement is due to the knowledge acquired at university.<br>● Ability to apply and practise his/her knowledge in mathematics, science and engineering.<br>● Ability to design a component, system or process to meet desired needs.<br>● Ability to communicate and function effectively in a team.<br>● Ability to recognize the need for, and to engage in life-long learning.<br>● Willing to work in the private sector. | ● 60% of alumni are working in the private sector.<br>● 20% of alumni have received any awards/recognition/appreciation from employers/companies. | ● 50% of alumni and employers rate competency improvement in the career complements the needs of the country and the global community as Good/Outstanding<br>● 50% of alumni and employers rate mastery of the latest knowledge in the field of engineering as Good/Outstanding<br>● 50% of alumni and employers rate practical skills improvement in the career as Good/Outstanding<br>● 50% of alumni and employers rate soft skills improvement in the career as Good/Outstanding<br>● 50% of alumni and employers rate communication skills in the career as Good/Outstanding |
| **PEO 3:** An engineer who is **creative and innovative**, has **entrepreneurial** and **leadership** qualities that are glocal. | Satisfaction of employers and external clients working with the graduates.<br>● Ability to perform well in associating with co-workers.<br>● Ability to perform well in dealing with suppliers/ vendors/ customers.<br>● Ability to perform well in different work environments. | ● 5% of alumni be a founder/owner/ operator of a company<br>● 15% of alumni are promoted to senior and managerial positions. | ● 50% of alumni and employers rate innovation opportunities in the career as Good/Outstanding<br>● 50% of alumni and employers rate entrepreneurial traits and mindset in the career as Good/Outstanding<br>● 50% of alumni and employers rate recognition of leadership qualities by employer in the career as Good/Outstanding |

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| | | |
|---|---|---|
| | • Ability to set up a company/business.<br>• Ability to expand his/her business or employer's business.<br>• Ability to lead others in professional tasks. | • 50% of alumni and employers rate recognition of leadership qualities by external stakeholders in the career as Good/Outstanding |

### 2.1 Direct PEO measurement

Fact-finding questions (not an opinion survey) that capture factual information on the alumni are used in assessing the program objectives and are considered the direct PEO measurement. The quantitative analysis of each of the PEOs is based on survey data collected from responses from 81 alumni who graduated between 2013 and 2023. The survey was conducted between June to July 2023.

Figure 1 shows that around 38 % of the respondents have three years or more of working experience. In short, the PEO achievements that are measured reflect the skills that are expected to be demonstrated by the students after the first few years of graduation.

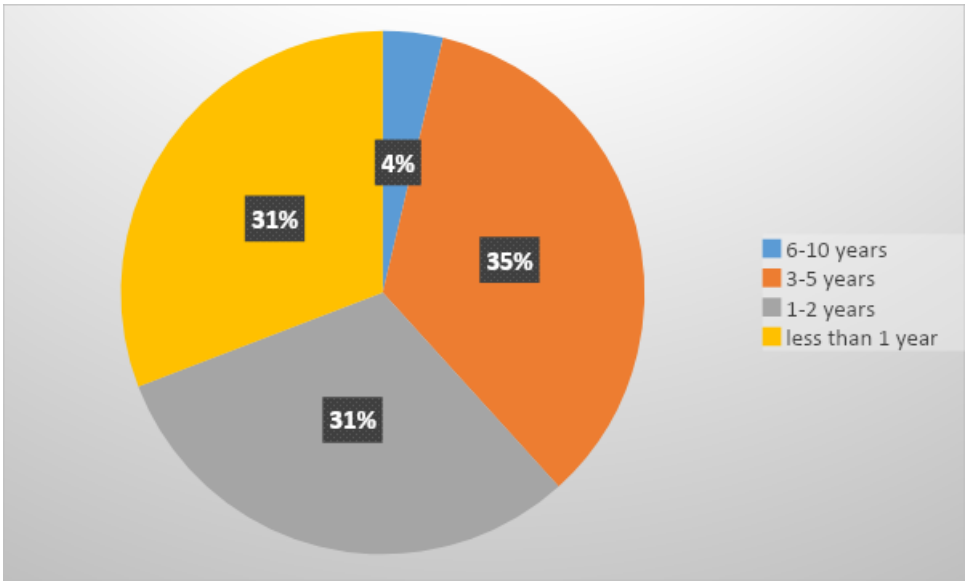


Figure 1. Alumni respondents' number of years of working experience

### 2.2 Indirect PEO measurement

For indirect PEO measurement, the alumni and employer's evaluations and perceptions are

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considered. In addition to the alumni survey, several employers have responded to the PEO questionnaires. Among the employers who have responded are:

- Amkor Technology Malaysia
- Greatech Integration (M) Sdn Bhd
- Huawei Malaysia
- Infinite Tooling Sdn Bhd
- Melewar Steel Tube Sdn Bhd
- OSK Group
- StarFive Technology International Sdn Bhd
- SkyeChip Sdn Bhd
- TE connectivity
- ViTrox Technologies Sdn Bhd
- VMware Singapore.

From the survey, the statement of PEO importance is determined based on the points scored from responses to questions relating to the respective PEOs. The points scored for each given response are evaluated based on the Likert's scale as follows: Scale: 1) Poor; 2) Below average; 3) Satisfactory/Average; 4) Good/Above average; 5) Outstanding. The scores for 1, 2 and 3 are considered as not meeting the PEO's target performance. Therefore, scores of 4 (Good/Above Average) and 5 (Outstanding) were extracted and compared between the alumni's perspective and the employer's perspective.

## 3.0 RESULTS AND DISCUSSION

This section presents the direct and indirect PEO attainment results based on the survey that was conducted. Figure 2 showed that 10 % of the alumni graduates are working in the Government sector/ government-linked companies (GLC), which proves the achievement of:

**PEO1**'s direct performance indicator. Meanwhile, a majority of the graduates, which is 84 % of respondents, are working in the private sector (of which 48 % are in private multinational companies, and 36 % are in private local companies). This percentage exceeds the target of **PEO2**'s direct performance indicator, which aims at 60 % of graduates working in the public sector. Moreover, 5 % of alumni involvement in their own business is also meeting the target **PEO3**'s direct performance indicator.

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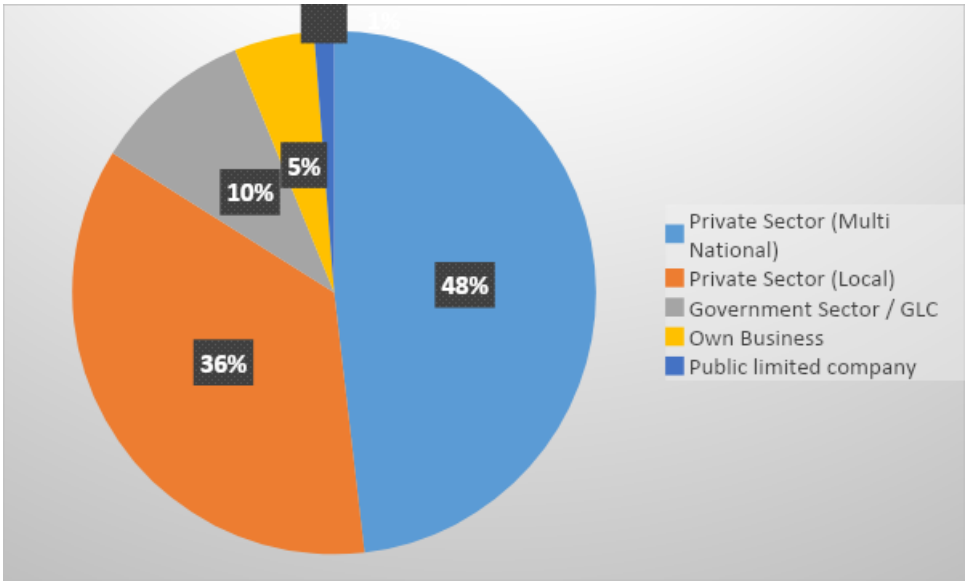


Figure 2. Company sectors for alumni graduates

Next, Figure 3 illustrated the proficiency level of communication skills in the Malay Language pertaining to career tasks among the alumni of the JKEES programme. The survey responses indicated that **PEO1** has surpassed the target of 50 % for the direct performance indicator related to alumni having good/above average communication skills in the Malay Language in career tasks, where 75.3 % is achieved according to the survey responses.

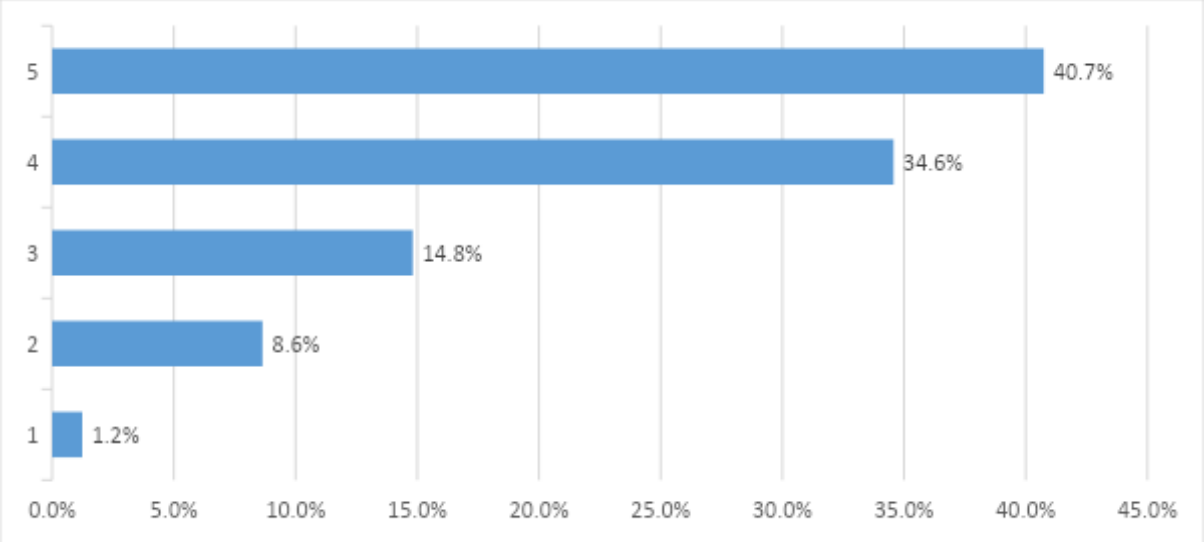


Figure 3. The proficiency of graduates' communication skills in the Malay Language for professional career tasks.

Professional growth may also be represented by awards/ recognition/ appreciation from the employer and career promotion. According to the data presented in Figure 4, it can be observed that 28.4 % of the employers have given awards/ recognition/ appreciation to the

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JKEES alumni. This exceeds the target **PEO2**'s direct performance indicator of 20 %. In Figure 5, the result showed that approximately 18.5 % of alumni were promoted to senior and managerial positions (senior engineer/senior executive, assistant manager and above). This exceeds the target **PEO3**'s direct performance indicator, which aims for 15 % of graduates to be advanced to senior and managerial positions after a few years of their career.

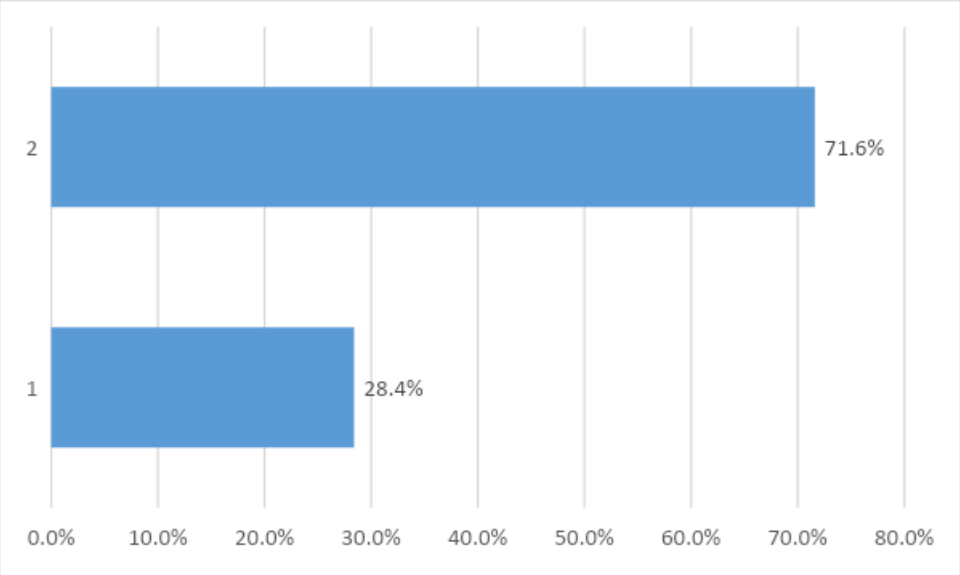


Figure 4. Graduates receiving awards/ recognition/ appreciation from the employer

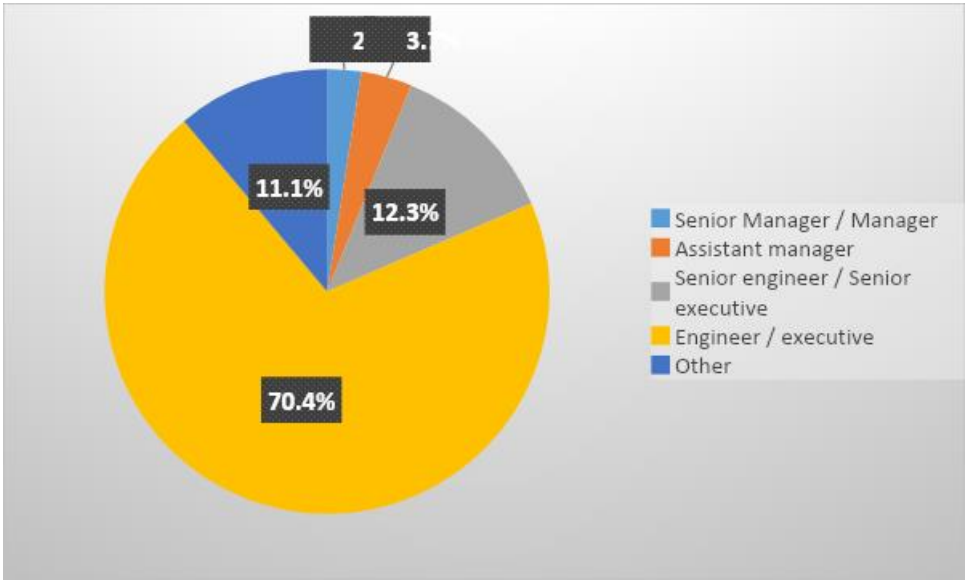


Figure 5. Alumni positions in the industry

Finally, the achievements of direct PEO measurements are summarised in Table 2. It can be seen that all target direct PEO indicators have been achieved.

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Table 2. Direct PEO target and achieved performance indicators

| PEO | Direct indicators | Target | Achieved |
|---|---|---|---|
| **PEO 1** | Alumni working in GLC/government sector. | 10% | 10% |
| | Alumni have good/above average communication skills in Malay Language in career tasks. | 50% | 75% |
| **PEO 2** | Alumni are working in the private sector. | 60% | 84% |
| | Alumni have received any awards/ recognition/ appreciation from employers/ companies. | 20% | 28% |
| **PEO 3** | Alumni be a founder/ owner/ operator of own company/ business. | 5% | 5% |
| | Alumni are promoted to senior and managerial positions. | 15% | 19% |

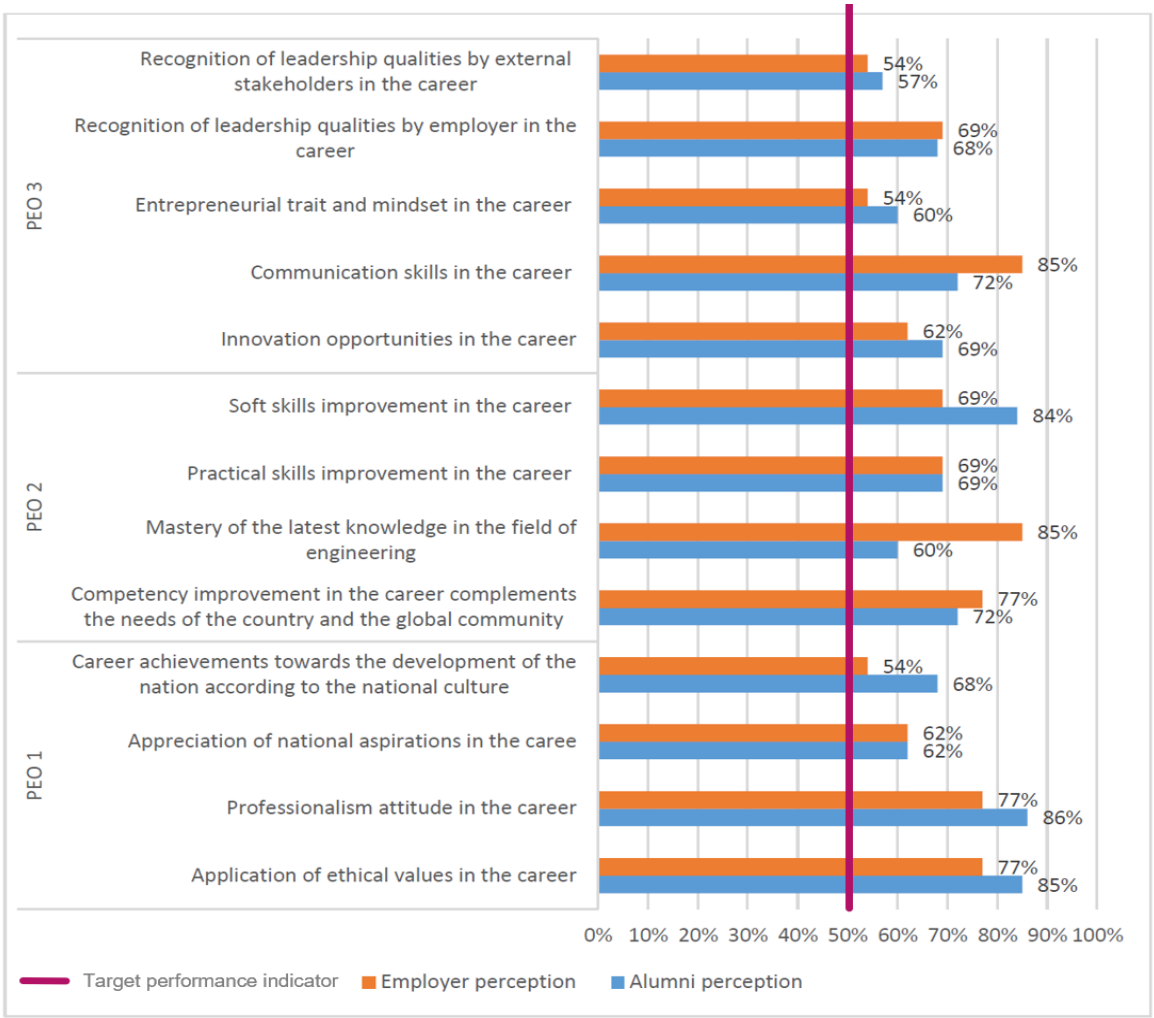


Figure 6. Alumni and employer perception of PEO achievements

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Table 3. Indirect PEO target and achieved performance indicators.

| PEO | Alumni and employer rate Good/Outstanding perception (Indirect indicators) | Target | Achieved |
|---|---|---|---|
| PEO 1 | Application of ethical values in the career. | 50% | Alumni: 85%<br>Employer 77% |
| | Professionalism attitude in the career. | 50% | Alumni: 86%<br>Employer: 77% |
| | Appreciation of national aspirations in the career. | 50% | Alumni: 62%<br>Employer: 62% |
| | Career achievements towards the development of the nation according to the national culture. | 50% | Alumni: 68%<br>Employer: 54% |
| PEO 2 | Competency improvement in the career complements the needs of the country and the global community. | 50% | Alumni: 72%<br>Employer: 77% |
| | Mastery of the latest knowledge in the field of engineering. | 50% | Alumni: 60%<br>Employer: 85% |
| | Practical skills improvement in the career. | 50% | Alumni: 69%<br>Employer: 69% |
| | Soft skills improvement in the career. | 50% | Alumni: 84%<br>Employer: 69% |
| PEO 3 | Innovation opportunities in the career. | 50% | Alumni: 69%<br>Employer: 62% |
| | Communication skills in the career. | 50% | Alumni: 72%<br>Employer: 85% |
| | Entrepreneurial traits and mindset in the career. | 50% | Alumni: 60%<br>Employer: 54% |
| | Recognition of leadership qualities by the employer in the career. | 50% | Alumni: 68%<br>Employer: 69% |
| | Recognition of leadership qualities by external stakeholders in the career. | 50% | Alumni: 57%<br>Employer: 54% |

As stated, indirect PEO measurement investigates and compares the alumni's perspective and the employer's perspective. The results were presented in Figure 6 and Table 3. In general, PEO 2 exhibited the highest average score in employer perception, whereas PEO 1 exhibited the highest average score in alumni perception. In PEO 1, national aspirations/national development are defined as harder-to-achieve attributes, where a target of 50% performance indicator is set. Meanwhile, PEO 3 has the lowest average score because several harder-to-achieve attributes are present in PEO, such as entrepreneurship and recognition of leadership quality from external stakeholders, where a target of 50 % performance indicator is also set. It can clearly be noted that the rest of the PEO's performance

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indicators have achieved more than 60 %, indicating that the programme has attained its target.

The findings indicated that the desired outcomes for both direct and indirect PEO targets have been successfully attained. According to the analysis of the survey, it is asserted that the undergraduate degree programme offered by JKEES has successfully generated graduates who are correlated with the objectives of the programme. The graduates have exhibited an unwavering commitment to augment their knowledge, accept swift technology advancements, and incorporate national agenda into their career pursuits.

## 4.0 CONCLUSION

This study provides a detailed explanation of the enhancements made to the performance indicators for measuring Programme Educational Objectives (PEOs). In order to assess the degree of PEOs achievement by alumni graduates, a thorough online survey has been designed and disseminated to both the graduates and the employers. The evaluation results are subsequently integrated into our quality enhancement strategy, which is aimed at consistently enhancing the achievement levels of the PEOs. By implementing measures to ensure the validity and relevance of PEO evaluations, it is possible to enhance the confidence level in the ability of students to acquire the necessary knowledge and competencies required for the success of their professional endeavours. It is believed that the PEO evaluation improvement exercise initiated by the Department is a significant step towards increasing the overall quality of the engineering course. Therefore, this will enhance the program's relevance and significance for students, while simultaneously increasing the graduate employability.

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