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Sustainable Assessment Practices for Engineering Programme Outcomes: Challenges and Recommendations in Malaysian Higher Learning Institutions*

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A new paradigm in the implementation of engineering programme outcomes assessment has emerged throughout Malaysia since the introduction of Outcomes-based Education (OBE) by the Engineering Accreditation Council of Malaysia in 2005. Despite the fact that OBE has been in place for over seventeen years, Malaysian Higher Learning Institutions (HLIs) continue to face challenges in effectively assessing programme outcomes. This research aimed to explore the challenges faced by academic staff when assessing programme outcomes at HLIs. The research was guided by the theory of sustainable assessment, as well as the key barriers identified by previous researchers that hinder academic staff from changing assessment practices. A qualitative methodology was employed, involving interviews with 18 participants to gain a comprehensive understanding of programme outcomes assessment in HLIs. The data was analysed using a constant comparative method, and themes were systematically examined and reported using Strauss and Corbin's coding analytical framework. The research revealed various emerging themes, including the need to change academic staff's mindset and increase their exposure to assessment, implementing effective HLI initiatives to enhance outcomes assessment, securing support from accreditation bodies to reduce assessment workload, establishing a robust outcomes-based support system, and working with dedicated and enthusiastic leaders. Based on the findings, sustainable practices for assessing engineering programme outcomes were proposed. These practices aim to address the challenges faced by HLIs and academic staff in engineering and other Science, Technology, Engineering, and Mathematics (STEM) education settings, foster the exchange of best practices, and improve the overall quality of STEM education globally.

Keywords: assessment practices; assessment workload; engineering programme outcomes assessment

1. Introduction

Studies from all over the world have demonstrated that assessing programme outcomes is arguably the most crucial criterion in Outcomes-based Education (OBE), which aims to enhance graduates' intellectual skills and capabilities [1–6]. The Engineering Accreditation Council Malaysia (EAC), in accordance with its standard for accrediting engineering degree programmes, mandates the assessment of programme outcomes [7]. Programme outcomes or synonymously known as graduate attributes, according to EAC, are the list the knowledge and skills students should have by the time they graduate [7]. These refer to the abilities and behaviours that students acquire throughout the course of the programme.

In 2009, the Board of Engineers Malaysia (BEM) was admitted being the full signatory of the Washington Accord for Malaysia as the 13th signatory of the current 23 signatories of the accord [6]. EAC is a body delegated by BEM to accredit engineering degree programmes. As a result, the Washington Accord's programme outcomes are the same as those of the EAC accredited programmes. The accord is a multilateral agreement between signatory countries that are responsible of accrediting or recognising tertiary engineering degrees in their respective countries [6]. It plays a crucial role in promoting global standards of engineering education and enhancing the international recognition of engineering qualifications and acts as a benchmark for engineering education across all signatory countries [8].

The accord has grown from six signatories in 1989 to a well-sought-after organisation with Indonesia being the recent 23rd signatory in 2022 [6]. This growth reinforces the importance of

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programme outcomes assessment as an essential aspect of engineering education. According to EAC [7], the programme outcomes were developed to assist engineering graduates in gaining the knowledge necessary to address new problems in preparing them for future technology and societal developments. The Sydney Accord and Dublin Accord which were established in 2001 and 2002, respectively, are similar to the Washington Accord but focus on the recognition of engineering technologist and engineering technician qualifications, covering the entire spectrum of engineering [9]. Together, the Washington Accord, Sydney Accord, and Dublin Accord facilitate global recognition and mobility of engineering professionals, ensuring that graduates from accredited engineering programs in signatory countries meet the established quality standards and are prepared to contribute effectively to the engineering industry on an international scale.

1.1 Global Initiatives and Faculty Challenges in Assessing Programme Outcomes

Accreditation bodies around the world have started various initiatives to enhance engineering education and assess graduates' intellectual abilities. For example, the Accreditation Board for Engineering and Technology (ABET) introduced the Engineering Criteria 2000 (EC2000) accreditation programme standards in 1995 with the goal of evaluating and improving graduates' intellectual skills and capabilities [10]. The Canadian Engineering Accreditation Board (CEAB) established the Engineering Graduate Attribute Development project in 2008 to assist Canadian engineering faculties and schools in adopting outcomes-based assessment during the transition period [11]. Similarly, Engineering New Zealand (ENZ), formerly the Institution of Professional Engineers New Zealand, published indicators of attainment in 2017 to assist Higher Learning Institutions (HLIs) in the assessment of programme outcomes [12].

Other initiatives not specific to engineering were seen such as the Tuning project [13] and the Asian University Network [14]. The former is a European Union initiative that began in 2000 with the goal of developing a shared understanding of what students should know and be able to do upon graduation from higher education programmes. The project has since expanded to Latin America, Africa, and other parts of the world. Both the Tuning project and the Asian University Network initiatives aim to improve the quality of higher education through collaboration and cooperation among universities. They recognize the importance of defining learning outcomes, competencies, and quality assurance standards in order to ensure that students receive a high-quality education that prepares them for the challenges of the 21st century.

Despite the global efforts to enhance both engineering and non-engineering education and assess graduates' intellectual capabilities, there have been concerns about the challenges faced by academic staff in assessing programme outcomes. Prados et al. [10] claimed that many HLIs in the US misunderstood the assessment and evaluation standards, even though the EC2000 places a lot of emphasis on programme outcomes. As a result, an enormous amount of unrelated course or programme data was often presented to the accrediting panel. This is definitely an unsustainable strategy pursued by institutions seeking programme accreditation. Additionally, the HLIs did not analyse the results thoroughly and provided vague strategies for utilising the data to improve the quality of their programmes through Continual Quality Improvement (CQI). The burden on academic staff has reportedly increased as a result of a lack of understanding of outcome assessment and the enormous amount of documentation required to prove the attainment of the outcomes [1, 15–20]. According to Briedis [21], HLIs faced additional challenges in preparing for accreditation, such as the use of inappropriate assessment tools and resistance from academic staff [20, 22, 23]. Numerous studies on engineering education have been conducted in response to these challenges in improving the efficiency of programme outcomes assessment through a reduction of time and effort [1–3, 5, 24–32]. On the other hand, both Uziak et al. [20] and Cooper [33] underscore the indispensable role of institutional management and strong leadership in driving sustainable change and ensuring successful programme assessment practices. By providing support, guidance, and a vision for improvement, leaders can pave the way for positive transformation in HLIs.

The analysis of the literature has resulted in the researchers grouping the problems into two categories: technical and social. The technical problems concentrate on constructive alignment and CQI in the curriculum as well as the teaching and learning activities; the social problem is more indirect where it involves the participation of all stakeholders in the processes of the first category. By addressing these technical and social challenges, HLIs can improve the effectiveness of programme outcomes assessment, leading to better educational quality and preparing graduates for the demands of the 21st-century workforce.

1.2 Theory of Sustainable Assessment in Engineering Education

One of the 17 Sustainable Development Goals (SDGs) that is focused on ensuring inclusive and

equitable quality education and fostering opportunities for lifelong learning for everyone is Quality Education (SDG 4). To enhance the education system primarily connected to assessment, Boud [34] and Boud and Falchikov [35] proposed the notion of sustainable assessment, which is analogous to the reframed definition of sustainable development [36]. The concept of sustainable assessment, as developed by Boud [34] and Boud and Falchikov [35], focuses on designing assessment practices that not only measure students' learning but also prepare them for real-world challenges they will face in their future workplaces. The goal is to equip graduates with the necessary skills and knowledge to function effectively in a complex society or work environment.

This aligns with the Washington Accord and EAC programme outcomes, which state that engineering students must be prepared for future technological and societal changes, as well as be able to acquire new knowledge and apply it to new problems [4, 9]. Additionally, the concept sustainable assessment was chosen to guide this research to address the sustainability of academic staff's efforts. By creating assessment practices that are purposeful, the research aims to reduce the burden that academic staff may experience due to assessment-related tasks. This can lead to a more efficient and effective education system, where academic staff can focus on guiding students' development and fostering a meaningful learning experience.

According to Beck et al. [37], sustainable assessment is part of a 'constructive alignment' between the teaching and learning, and assessment activities promoted by Biggs [38]. The idea is that assessment should be integrated with instruction and learning so that graduates are prepared to evaluate their capacity to learn in a variety of non-academic, moderately challenging circumstances after graduation. As described by Boud [34] and Boud and Falchikov [35], sustainable assessment theory has four principles: (1) focus on long-term learning outcomes that are applicable not only to course activities but also to the workplace; (2) explicit criteria defining programme outcomes where students are aware of the expectations and standards against which their performance will be evaluated; (3) both students and academic staff actively participate in the assessment process which emphasises the importance of involving students in the assessment process, encouraging them to take ownership of their learning and development; and (4) development of devices that allow students to monitor and evaluate their own progress towards achieving the learning outcomes.

In summary, the principles of sustainable assessment focus on long-term learning outcomes applicable to real-world scenarios, provide explicit criteria for student outcomes, involve students in the assessment process, and promote self-monitoring and self-regulation in students' learning journeys. The first two principles of sustainable assessment deal with the setting of standards and criteria of assessment at the faculty and institutional level have a direct impact on the present research.

1.3 Conceptual Framework

First, there is a need to define sustainable assessment in the context of engineering programme outcomes. The definition of sustainable development was outlined by the United Nations World Commission on Environment and Development [36]. The panel, which was founded in 1983, issued a report in 1987 under the title *Our Common Future*. It laid the foundation for sustainable development as it is now commonly understood. Since then, studies on education have been undertaken by Boud [34], Boud and Falchikov [35], Fullan [39], and Van den Branden [39] that support the concept of sustainable development.

The present research emphasised the importance of analysing the challenges and factors that affect how engineering programme outcomes are evaluated from stakeholders' perspectives. It was conducted to highlight the assessment burden on the academic staff and was guided by the philosophy of sustainable development [34–36, 39–41]. To accomplish this, the present research concentrated on the challenges faced by academics in engineering faculties when putting assessment plans into practice. Then, at the institutional level, workable measures to lessen the assessment burden were proposed (referred to in the present research as sustainable assessment practices). The research results can be utilised by stakeholders such as HLIs, faculties, and accreditation bodies to assess engineering programme outcomes effectively without overburdening academic staff.

Fig. 1 illustrates the conceptual framework of the present research. To relate issues on "sustainable assessment and effort," the notion of sustainable assessment theory by Boud [34], Fullan [39], Hattie and Timperley [41], and Van den Branden [40] is used as a foundation. This theory provides a basis for understanding the principles and concepts of sustainable assessment. The second notion integrated into the framework is Biggs' [38] model of constructive alignment. As mentioned by Beck et al. [37], sustainable assessment is part of "constructive alignment," where teaching, learning, and assessment activities are interconnected and aligned with learning outcomes. The present research addressed the limitations and challenges faced by academic

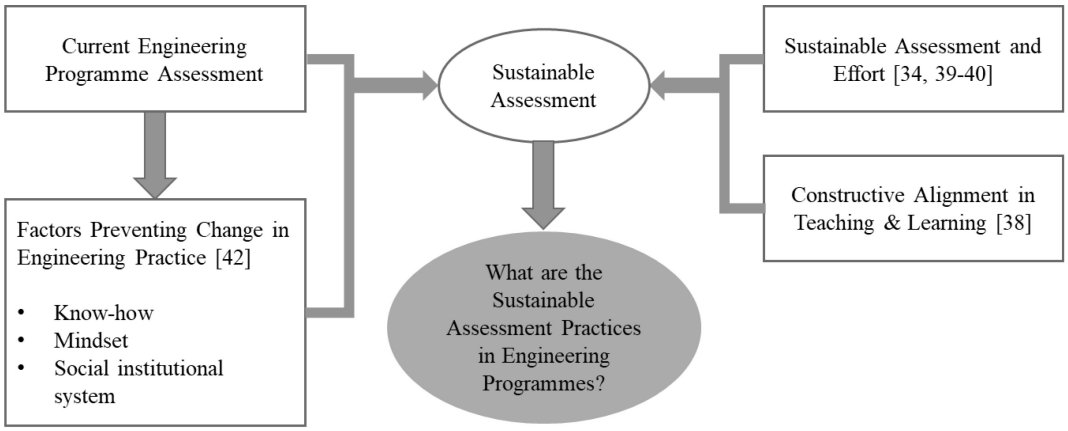

Fig. 1. Conceptual framework of the research.

staff in changing assessment techniques in the current engineering programme assessment, as identified by Biggs [42]. The goal is to identify sustainable assessment practices within the existing engineering programme outcomes assessment.

Fig. 1 visually represents the relationships between the variables under investigation, highlighting the analysis of discrepancies between the ideal state (sustainable assessment) and the current state in the engineering programme outcomes assessment. The framework provides a systematic approach to explore and address the issues of sustainable assessment and effort within the context of engineering programme outcomes assessment.

The research objectives of the present research are twofold. First, it aims to investigate the current challenges faced by stakeholders in the Malaysian context. Second, it seeks to identify sustainable practices for assessing engineering programme outcomes in Malaysian HLIs. To achieve these objectives, the following research questions were formulated: ''What challenges do Malaysian HLIs encounter when assessing programme outcomes?'' ''What strategies do they employ to overcome these challenges?''

By investigating the challenges experienced by Malaysian HLIs, the research aims to gain valuable insights into the issues faced by engineering education stakeholders in Malaysia. Understanding these challenges will provide a more comprehensive understanding of the context and can lead to the development of context-specific and sustainable assessment practices. Additionally, the findings of this research may have broader implications beyond Malaysia. Other HLIs, academic staff, and accreditation bodies in different countries can learn from the sustainable assessment practices identified in the Malaysian context. The research may offer valuable insights for addressing similar challenges in other Science, Technology, Engineering, and Mathematics (STEM) education settings, promoting the exchange of best practices and improving the overall quality of STEM education worldwide.

2. Methodology

This research applied a qualitative approach in seeking answers to the research questions. A qualitative method was chosen in investigating the challenges and factors that affect how programme outcomes were assessed in the HLIs. The grounded theory method was used to collect, triangulate, combine, and analyse the data which aims to develop theories directly from the data rather than testing pre-existing theories [43]. Table 1 provides a summary of the research questions, data collection strategy, and data analysis method used to create the operational framework for conducting this research.

Before identifying the sustainable practices for assessing the programme outcomes for EAC, there

Table 1. Research design of this research

Research Question	Data Collection	Data Analysis	Participants
What challenges do Malaysian HLIs encounter when assessing program outcomes? What strategies do they employ to overcome these challenges?	Semi-structured interview	Constant comparative method	[1] Present or former office bearers of EAC (accreditation body) [2] Reviewers from the Washington Accord's signatory countries [3] Senior panel reviewers of EAC, academic staff and/or programme owners

are two phases of work involved; interview protocol design and the interview.

Phase 1: Design of Interview Protocol

The researchers analysed existing research on engineering education programme outcomes assessment models from different HLIs in Malaysia and other countries that are signatories of the Washington Accord. This helped to gather valuable insights from previous studies. The researchers conducted informal discussions with current or former office bearers of EAC, which is a unit responsible for accrediting engineering programmes in Malaysia. These discussions provided additional perspectives and real-world experiences related to the assessment process. The interview protocol was developed using the findings from the literature review, the first author's participation in accreditation visits, and informal discussions with EAC office bearers. This ensured that the questions in the protocol were relevant and aligned with the research questions. The interview protocol was validated by two experts: a qualitative research expert from a social science background and an EAC office bearer. Their expertise ensured that the protocol was robust and comprehensive. To gather potential answers to the questions and test the effectiveness of the interview protocol, a pilot interview was conducted with two academic staff who also served as panel reviewers. The insights from this pilot interview allowed for relevant adjustments and improvements to be made to the protocol.

Overall, this phase used a systematic and thorough approach to gathering data and insights about the issues with the current engineering programme outcomes assessment. The combination of literature review, informal discussions, and a pilot interview added depth to the research findings and enhanced the credibility of the research. A semi-structured interview protocol was used to facilitate the interviews.

Phase 2: Interviews

Before the research commenced, each participant was asked to sign an informed consent form. This form ensured that the participants were informed about the research's purpose, what their involvement entailed, and their rights as research subjects. It is an important ethical requirement in conducting research involving human participants. The interviews were conducted in English and recorded in audio format. Afterward, the recordings were transcribed to convert the spoken content into written form, which makes it easier to analyse and interpret. The results of the literature review were first presented to the interviewees, who were then asked to describe how programme outcomes are assessed in their departments, schools, or faculties. They were also asked about the challenges they had faced and the level of support that had been given to them.

NVivo 12, which is a qualitative data analysis software, was used to analyse the transcribed data. This helped to organise, code, and make sense of large amounts of qualitative data efficiently. As mentioned earlier, the constant comparative approach proposed by Glaser and Strauss [44] and Strauss and Corbin [43] was utilized to compare and contrast the viewpoints and opinions of different participant groups to identify patterns and themes in the data. This helped to ensure a more comprehensive understanding of the research topic.

Overall, this phase allowed for in-depth exploration and analysis of participants' perspectives and experiences. Additionally, the ethical consideration of obtaining informed consent is crucial to protect the rights and well-being of the research participants.

2.1 Sample Size and Participants

The present research's sampling strategy aimed to gather insights from a diverse group of experts with direct involvement in engineering programme accreditation in Malaysia. By categorising the participants based on their roles and experiences, a broad range of perspectives on the research topic can be captured.

The research employed purposive sampling, which means that the participants were deliberately chosen based on specific criteria to meet the research objectives. These purposive sampling criteria were described by Creswell and Plano Clark [45] and Spradley [46]. The two preferable criteria for participant selection were:

(a) Academic staff from engineering faculties: the participants needed to be affiliated with engineering faculties as academic staff members. This ensures that they have relevant expertise and knowledge in engineering education.
(b) Experience with accreditation of engineering programmes: additionally, the participants must have experience with the accreditation process of engineering programmes. This ensures that they have direct involvement or knowledge of the process under study.

In total, 18 participants were recruited, 17 of whom were academic staff from engineering faculties and all of whom were involved in the accreditation of four-year engineering programmes in Malaysia. The 18 participants were further divided into two distinct groups based on their roles and experiences:

Table 2. Profile of research participants

Name	Country	University/ Company	Academic Post	Admin Post	AccreditationInvolvement (Past or Present)	Years as Panel Reviewer	Discipline	Remarks
Carol	United States	University X	Professor Emerita (retired)	Associate Dean (former)	ABET, Adjunct Director	> 10 years	Electrical	International Reviewer
Hong	Taiwan	University Y	Professor	Dean	Institute of Engineering Education Taiwan, Executive Director	Not known	Mechanical	International Reviewer
Annika	South Africa	Company Z	–	General Manager	Engineering Council South Africa, Panel Reviewer	> 15 years	Electrical	International Reviewer
Ahmad	Malaysia	University A	Professor	Dean (former)	EAC, Director and Associate Director (former)	> 20 years	Civil	International Reviewer
Nora	Malaysia	University B	Professor	Dean	EAC, Associate Director	> 5 years	Electrical	–
Cheng	Malaysia	University C	Associate Professor (retired)	–	EAC, Associate Director (former)	> 10 years	Mechanical	–
Chan	Malaysia	University D	Professor	Deputy Dean (former)	EAC, Panel Reviewer	> 10 years	Telecommu-nication	–
Ramesh	Malaysia	University E	Professor	Deputy Dean	EAC, Panel Reviewer	> 5 years	Electrical	–
Helmi	Malaysia	University F	Professor	Deputy Dean	EAC, Panel Reviewer	> 10 years	Electronics	–
Anwar	Malaysia	University G	Professor	Dean	EAC, Panel Reviewer	> 5 years	Electronics	–
Suhana	Malaysia	University H	Professor	Dean	EAC, Panel Reviewer	> 5 years	Telecommu-nication	–
Kamal	Malaysia	University I	Professor	–	EAC, Panel Reviewer	> 5 years	Electronics	–
Wang	Malaysia	University J	Associate Professor	–	EAC, Panel Reviewer	> 5 years	Electrical	–
Sabri	Malaysia	University F	Professor	–	EAC, Director and Associate Director (former)	> 15 years	Civil	–
Linlin	Malaysia	University K	Professor	Dean	EAC, Panel Reviewer	> 10 years	Electronics	–
Liang	Malaysia	University D	Associate Professor	Head of Programme (former)	EAC, Panel Reviewer	> 5 years	Electronics	–
Teng	Malaysia	University L	Professor	Dean	EAC, Panel Reviewer	> 10 years	Electronics	–
Dinesh	Malaysia	University M	Professor	Dean	EAC, Panel Reviewer	> 5 years	Electronics	–

(a) Present or former EAC office bearers: individuals who have held positions within the EAC at some point in time.
(b) Senior panel reviewers of EAC and/or Washington Accord signatory countries: experienced individuals who serve as senior panel reviewers for the EAC and/or Washington Accord. They are also affiliated with engineering faculties, either as academic staff and/or programme owners.

Table 2 summarises the participant profiles with pseudonyms to maintain anonymity and confidentiality.

2.2 Data Analysis

The initial step in the present research's data analysis is to make a verbatim transcription of the interviews. As described earlier, the constant comparative approach was used in finding, analysing, and reporting themes in the data. To ensure the accuracy and reliability of the research findings, two qualitative research experts from Universiti Teknologi Malaysia validated the themes that were coded from the interview transcripts. Data validation involves having independent experts review and confirm the identified themes and interpretations, adding to the research credibility.

After identifying the themes through the constant comparative approach and validating them, these themes were presented in the research report. Themes are the recurring patterns, topics, or ideas that emerged from the data analysis. They represent important insights and findings related to the research question. To support the discussions for the identified themes, the relevant quotes from the interviewees were presented under each theme. These quotes serve as direct examples of participants' perspectives and experiences related to the themes. To protect the privacy and anonymity of the interviewees, pseudonyms were used instead of their real names.

2.3 Interpreting the Findings

In order to systematically connect the themes, the coding analytical framework by Strauss and Corbin

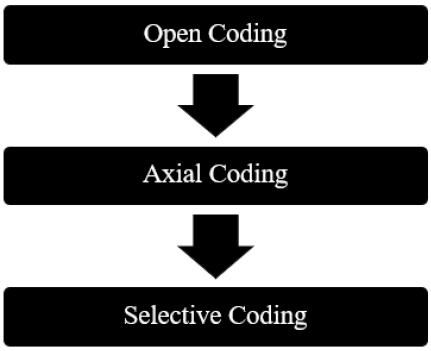

Fig. 2. Coding analytical framework employed in this work.

[43] was employed to link the codes (Fig. 2). The framework provides a more meaningful context to the research data as compared to Taylor et al.'s [47] interpretations of the data via two types of coding; open coding and focused coding.

Strauss and Corbin [48] refer to the process of analysing data as coding. The three-level of analysis (open-axial-selective) was performed in gathering a complete picture of the information gathered during the data collection. During the open coding stage, the researchers compared the data from all the transcripts. The categories and properties in the open coding stage emerged from several rounds of re-reading of the transcriptions. The common sub-themes were then identified during the open coding process accompanied by relevant excerpts from the interview transcripts. Next, axial coding was carried out by analysing the connections between the categories and properties identified during the open coding stage. This is where "the inductive and deductive thinking process of relating subcategories to a category" happens, making it the main emphasis of the axial coding stage [49]. Re-readings of the transcriptions were carried again out to ensure that the subcategories fall under the specific subcategories accordingly. These subcategories were constructed both from the review of the literature and emerging themes from the interviews. Selective coding was finally performed to systematically identify the core categories and ensure that they are relevant to the challenges faced by the participants while assessing the engineering programme outcomes. The refinement process was carried out by refining the major categories into the selection of the core categories in answering the research questions.

3. Results and Discussion

3.1 Challenges Affecting the Assessment of Programme Outcomes

The results of this analytical framework are shown in Table 3, which considered the interaction between the categories and properties with the subcategories and core categories in the analytical framework by Strauss and Corbin [43]. The table provides a representation of how the various categories and properties identified through open and axial coding are linked to the subcategories and core categories, allowing researchers to gain insights into the relationships and patterns within the data.

The present research identified four core categories of challenges experienced by the participants namely Diverse expectations of panel reviewers, Poor directions from the accreditation body, Negative mindset and know-how of the academic staff and Poor institutional governance. The following section presents the discussions on each of the challenges as reported from the words of the participants.

3.1.1 Diverse Expectations of Panel Reviewers

The HLIs believe that the panel reviewers are subject matter experts on the assessment criteria. However, it was observed that different panel reviewers have various interpretations of the assessment requirements. In most cases, the panels were promoting the practices of their faculties rather than the standards of the accreditation requirement. Consequently, this has resulted in **conflicting assessment recommendations** from the panel reviewers. The former director of the Engineering Accreditation Department expresses his concern over this matter:

> "We never specified any [assessment] model in Malaysia. Tell you the truth in Malaysia. May be some panel evaluators may have excess baggage of what they carried in their universities they demand that. But as far as EAC [Engineering Accreditation Council] we have never actually said that is the model [assessment] but what we said is you have to demonstrate." (Ahmad)

This quote highlights the need for greater clarity and uniformity in the accreditation requirements. It suggests that there might be room for improvement in terms of providing explicit guidelines to panel reviewers, ensuring they focus on the established accreditation requirements rather than promoting their individual faculties' practices.

Another panel reviewer concurred with the former director's statement, emphasising that panel reviewers evaluate whether the outcomes have been achieved but do not dictate how the assessment should be conducted:

> "As an evaluator [panel reviewer], we check to see if the outcome has been met but we never prescribe to the university how the outcome assessment must be assessed or which subject contributes to the outcome.

Table 3. Themes and sub-themes on the challenges for assessing engineering programme outcomes

No.	Open coding (category and property)	Axial Coding (subcategory)	Selective coding (core category)
1a	Different interpretations of assessment requirements	Conflicting assessment recommendations	Diverse expectations of panel reviewers
1a	Lack of understanding on assessment requirements		
1a	The need for retraining		
1b	Favouritism	Lack of professionalism	
1b	Making unnecessary requests from HLIs		
1b	Unwilling to learn		
2a	Absence of guidance from assessing culminating courses	Lack of guidance on programme assessment	Poor directions from the accreditation body
2a	Deny template mentality		
2a	Wasted time and effort		
2b	Freehand given	Lack of guidance on assessment requirements	
2b	Too general direction		
2c	Other	Inadequate training to IHLs	
3a	Additional workload	Feeling of burdensome	Negative mindset and know-how of the academic staff
3a	High frequency of accreditation visits		
3a	Lack of appreciation on assessments		
3b	Lack of improvement spirit	Lack of culture in assessment	
3b	Poor attitude toward assessment		
3c	Lack of understanding on assessment requirements	Lack of knowledge in assessment	
3c	Lack of understanding on constructive alignment		
3c	Unable to identify the correct assessment tools		
4a	Ad-hoc accreditation taskforce	Poor cultivation of culture	Poor institutional governance
4a	Not looking for sustainable solutions		
4a	Not quality-driven		
4b	Inadequate training provided to academic staff	Poor leadership	
4b	Poor support for OBE implementation		
4b	No progress on OBE implementation		
4c	Ineffective succession plan	Poor human resource management	
4c	Insufficient manpower		

> The assessment model to achieve all the outcomes must be developed by the university.'' (Annika)

However, despite this approach, some panel reviewers were found to be unclear on the assessment requirements. Such incompetent reviewers or **lack of professionalism** could undermine the integrity and credibility of the accreditation assessments, and were revealed by the following participant:

> ''Some panels [reviewers] don't care about the definitions [of programme outcomes], I think some of them don't even understand the twelve programme outcomes themselves.'' (Sabri)

In addition, accreditation standards can be interpreted in a variety of ways, which leads to different interpretations of assessment requirements. When interpreting the requirements, Sabri notes that . . . ''then again we fall back to our own definition, each lecturer, each panel [reviewer] will have his own interpretation.'' The HLIs often encountered problems and misunderstandings due to conflicting suggestions made by different panel reviewers who are supposed to be educated about the assessment requirements. These conflicting interpretations have practical consequences for the institutions assessing programme outcomes. This lack of alignment and professional conduct can create unnecessary burdens for the institutions, as exemplified by excessive data collection and preparation to meet the varying demands of panel reviewers.

Some participants claimed that panel reviewers **lacked professionalism** by making unnecessary requests before and during accreditation visits, resulting in excessive data collection and preparation. Such requests include the panels' preferences for document arrangement and interventions during the scheduled itinerary visit. The following quotations exemplify such unnecessary requests:

> ''May be the one who comes for accreditation need to reduce some of the collections, may be you have asked too many things up to the very detail.'' (Nora)

> ''The panel [reviewers] should not be demanding too much so to add or request unnecessary documentation. Unnecessary [for example] means they want the documents to be arranged according to their own requirements. Certain panel [reviewers] have special requests, things like that.'' (Chan)

Furthermore, some panel reviewers were observed to show preferences towards certain institutions. This type of bias can undermine the fairness and objectivity of the accreditation process, raising concerns about the need to address potential favoritism to ensure equal treatment and opportunities for all institutions. According to Linlin, some panel reviewers would favor public universities compared to the private ones:

> "Another thing is it seems local [public] universities, they have more privileges. Some favouritism behind. So EAC [Engineering Accreditation Council] need to think of how to overcome this." (Linlin)

3.1.2 Poor Direction from Accreditation Body

Lack of guidance on the programme assessment from the accreditation body is a significant factor contributing to the academic staff's perception of burdensome. Sabri highlights that without a clear template or guidance, the HLIs struggle to find the right approach to meet the assessment requirements. This leads to wasted time and effort, as they go through trial-and-error processes to figure out the appropriate methods for assessment. He gave the following example: "At the moment, that could also be a reason, why we [accreditation body] are not moving fast enough because we always deny the template mentality, we don't have template. Whereas if you leave them [the universities] without a template, you know you are not going to get the right answers, the right solutions, we wasted years, we wasted a lot of years leading the universities to look for all these things."

One solution to reduce the assessment burden lies with the accreditation body itself by defining the **assessment requirements**, as one panel reviewer notes below:

> "The accreditation body is responsible of reducing the burden. Again, the amount of work associated with the accreditation process can be controlled or modified by the accreditation agency." (Hong)

However, the flexibility given by accreditation body to address the **assessment requirements** of the accreditation standards can lead to misinterpretations among the HLIs, as noted by Ahmad below. The general descriptions in the assessment requirements may result in various interpretations from different HLIs, leading to confusion and inconsistencies in their approach to assessment.

> "EAC [Engineering Accreditation Council] has never actually asked them [the institutions] to prepare the massive data. EAC . . . [has] given them the freehand what they need to do is to address the requirements of the manual." (Sabri)

Chan emphasised that the "freehand" granted to HLIs might be a source of the burden:

> "EAC [Engineering Accreditation Council] manual provides a general guide but interpretation is different if you are from different universities or background. I have visited some universities complaining about this and lecturers also complaining about this. Even if you read the [accreditation] manual, you cannot know precisely what to do, because it is too general."

The requirements' description in the accreditation standards is too general for the HLIs to understand, resulting in various interpretations from the HLIs.

Some of the participants, according to Sabri, believe that the institutions were being victimised because the accreditation body **did not provide adequate training for the HLIs**. It failed to equip the HLIs and panel reviewers with enough training:

> "When the panel evaluators are not trained, they themselves are not well-versed in the things you are looking for, they may come up with the wrong recommendation, they are victimising the university."

The present research discovered that the HLIs suffer major effects as a result of the accreditation body's lack of guidance, with a great deal of time and effort being squandered on trial-and-error learning instead of focusing on innovation and improvement. The accreditation body has the most influence on sustainable assessment since they update panel reviewers' knowledge of assessment and explain the most recent assessment standards to HLIs.

3.1.3 Academic Staff Issues (Negative Mindset and Know-How)

The participants in the present research expressed the **feeling of the additional burden** and stress related to the additional workload required for evidence-keeping and data collection for programme outcomes assessment as pointed out by Hong, "Keeping class records [for programme outcome assessment] requires extra work which also adds to the already heavy burden on the professors."

Wang claimed that the assessment requires substantial data collection and preparation from academic staff. His disappointment with the assessment is demonstrated in the following excerpt:

> "The issues lead to massive data preparation and excessive data collection are the work leads to data analysis which becomes additional workload for staff and the data needs to be [also] properly stored for couple of years." (Wang)

The necessity to engage in data analysis and storage to determine and retain the records of students' outcomes resulted in massive amounts of data to be collected, and much planning to be done. As a result, tabulating and analysing the data became labor-intensive for the academic staff. The following participant, who was convinced that over-assessment places an undue burden on the academic staff, concurred with Wang's assertion:

> "As programmes begin doing assessment, there is a tendency to measure every outcome in every possible course. . ... Many programmes do too much assessment, which puts an undue burden on the faculty." (Carol)

It is evident that the comprehensive data preparation and collection requirements for programme outcomes assessment lead to added stress and workload for academic staff. Additionally, Cheng made an interesting insight, "Each university interpret it [EAC's accreditation standard] differently so we end up some micro-manage and some macro [universities] managed on programme outcomes." This revealed that the practices of other institutions and varying interpretations of the accreditation standards contribute to micro-management or macro-management of programme outcomes assessment across HLIs.

The concept of "assessment culture" refers to the characteristics of the assessment process and practice that are ingrained and shared throughout the entire institution. Participants in the research noted that this assessment culture is lacking in most HLIs. They argued that for institutions to effectively improve the quality of graduates, a culture of assessment needs to be cultivated. The establishment of such a culture would help academic staff recognise and accept the importance of assessment practices, leading to reduced feelings of overburdening. Sabri emphasised that the burden of assessment is often felt more by those who fail to see the value and benefits of the process. In contrast, those who recognise the real benefits may find the workload less burdensome:

> "Once [when] we want to do something new, it will always be burdensome to many, and only a few will not feel it because they will see the real benefit. We always look through ourselves, not to the interests, in our case, our students. And I mean the requirement, it is still burdensome if you still don't see the value, no matter how less or how much work or effort." (Sabri)

The shift towards a culture of CQI would facilitate the process of assessment, as Ahmad notes below. This implied that once the institution embraces an assessment culture, the models and approaches used for assessment would become more manageable and effective.

> "May be we cannot avoid that because the culture [of CQI] may not be there, the DNA is not there. So once the DNA is there, I think whatever model that you use can actually facilitate things." (Ahmad)

However, some participants have observed that Malaysian HLIs generally have a negative attitude on assessment, as Hong phrases it: "First of all, there is a need to establish the right attitude so that the professors view outcome assessment as part of their job." According to the statement above, the challenge is convincing academic staff that outcome assessment is an essential part of their profession. The **lack of an assessment culture** results in negative attitudes among academics, leading some to believe that only specific groups of people are responsible for assessment, rather than recognising its importance and relevance to their roles. Ahmad also felt that the move from traditional teaching and learning to OBE is to blame for the academic staff's lack of motivation because it is more laborious, as it involves not only teaching but also monitoring students' progress and ensuring their learning outcomes are achieved.

> "I think the greatest challenge is to get the academic staff to want do it [to assess programme outcomes] because this is somewhat more laborious [than] it used to be. In those days, you can teach whatever you like and assess them and that's it, you are the master. Now, it is a bit different, isn't it? You have to look at their [students] progress, you have to make sure that they actually learned. It is not only teaching but the learning process." (Ahmad)

A few participants observed that programme outcomes are assessed to get accredited rather than to find a long-term sustainable solution. The following quotation demonstrates how the HLIs are seen conducting it to satisfy the minimum requirements set forth by the accreditation body (EAC). This checkbox-driven approach focuses on fulfilling accreditation standards rather than genuinely improving the quality of education.

> "From my opinion, most institutions are 'checkbox' driven when it comes to assessing programme outcomes. They are also accreditation driven. Very few are quality driven." (Ramesh)

According to Ahmad, "if their [HLIs] aim is to just get accredited, it will never work." It should be made clear that without a genuine commitment, an assessment model will not succeed if it is only designed to satisfy accreditation requirements. Academic staff may feel frustrated and dissatisfied when preparing for accreditation under such a model that is only used for accreditation purposes.

Additionally, numerous participants disclosed that poor constructive alignment and improper assessment tools were used in the assessment of programme outcomes. This is quite significant because an experienced panel reviewer pointed out this incompetence. He believes that the problem of constructive alignment is exacerbated by the fact that many academic staff **lack knowledge in assessment of programme outcomes**:

> "It's the dissemination of knowledge, if the lecturers themselves do not know, they don't even define the programme outcomes to begin with. You need to know what are looking [to look] for . . . First, I suspect the lecturers don't have the knowledge and you've got to

> guide them on how to assess the indicators, that is the first step to make everyone understand. . . (Sabri)

Participants expressed their displeasure with the lack of an effective process in many HLIs. For instance, according to Teng, the adoption of suitable assessment approaches has a substantial impact on constructive alignment, necessitating a collaborative effort at the faculty level to ensure effectiveness. One participant, Ramesh continued to support Teng's view on faculty's critical role and iterated that ". . . this has to be defined at the faculty level."

The conceptual framework shown in Fig. 1 is consistent with the themes regarding academic staff that are described above. The theme, *feeling of burdensome* experienced by academic staff is consistent with Fullan's [39] and Van den Branden's [40] conceptions of sustainable educational systems. The second theme of *lack of culture* is connected to Biggs's description of "mindset" as one of the barriers to changing assessment techniques [42]. The final theme, *lack of knowledge*, is connected to yet other barriers to changing assessment practices namely "know-how" [42] and "constructive alignment" [38].

3.1.4 Poor Institutional Governance

Nora emphasised that **poor cultivation of culture** is evident in Malaysian HLIs. She asserted that programme owners must foster and sustain an assessment culture among academic staff. "But that requires some culture, if the culture is not there, you cannot say it is OK to have without that. Many of us is still in infancy [stage] actually." Nora pointed out that many institutions are still in the early stages of understanding and implementing OBE, indicating a lack of comprehensive adoption and integration. Without such a culture, the adoption of **OBE** has made little to **no progress**.

Cheng raised the issue of inadequate training for academic staff as a contributing factor to the slow progress in adopting OBE, saying, "I think that is another difficulty but if the lecturers have been trained properly, they know what assessment to give at the end of the day." Proper training can equip academic staff with the knowledge and skills necessary to implement effective assessment practices aligned with the OBE approach.

Leadership plays a crucial role in establishing and sustaining an assessment culture within institutions. The remark below serves as an example of how **poor leadership** has impeded the long-term implementation of programme outcomes assessment. Teng emphasised that buy-in and support for assessment practices must come from top-level leadership and be disseminated throughout all levels of the institution.

> "So I think the buy in will have to come from the very top level all the way to the ground. And there are also many instances where OBE is understood only at the higher level, but it is not getting down to the ground level [staff]." (Teng)

Manpower is desperately needed to effectively monitor the implementation of programme outcomes assessment, follow-up on programme improvements, and collection of relevant data from academic staff. However, private institutions faced more significant challenges with manpower compared to public-owned universities. Public institutions tend to have more resources and administrative staff available to assist with assessment matters and documentation. In contrast, private institutions often lack dedicated administrative support for assessment-related tasks as highlighted by Chan and Liang:

> "In some government [public-owned] universities, they have enough manpower to do that. That's why we need to increase the administrative to assist on EAC [Engineering Accreditation Council] matters. Though we have a specific centre at the university level, the Quality Department to handle accreditation but documentation is by the faculty." (Chan)

> "It is better to have an administration staff to help to key in the information. Unlike some public universities where they have dedicated administration staff to help." (Liang)

A lack of manpower can hinder the efficient implementation of the assessment system. Carol and Ahmad highlighted the importance of a **succession plan** and long-term commitment from HLIs in ensuring the sustainability of the assessment system, saying:

> "The current administrative system does not support keeping a good program leader who is willing to execute all these housekeeping works." (Carol)

and

> "There may be one or two people which may not be enough and these two people move on, that is the end of your system, and sometimes these people developed and they left." (Ahmad).

This highlights the importance of having a well-structured and stable administrative support system to maintain continuity and effectiveness in the assessment process.

3.2 Sustainable Elements for Assessing Engineering Programme Outcomes

The analytical framework proposed by Strauss and Corbin [43] was used to systematically link the interview findings, as shown in Table 3. Fig. 3 further classifies the themes under the categories

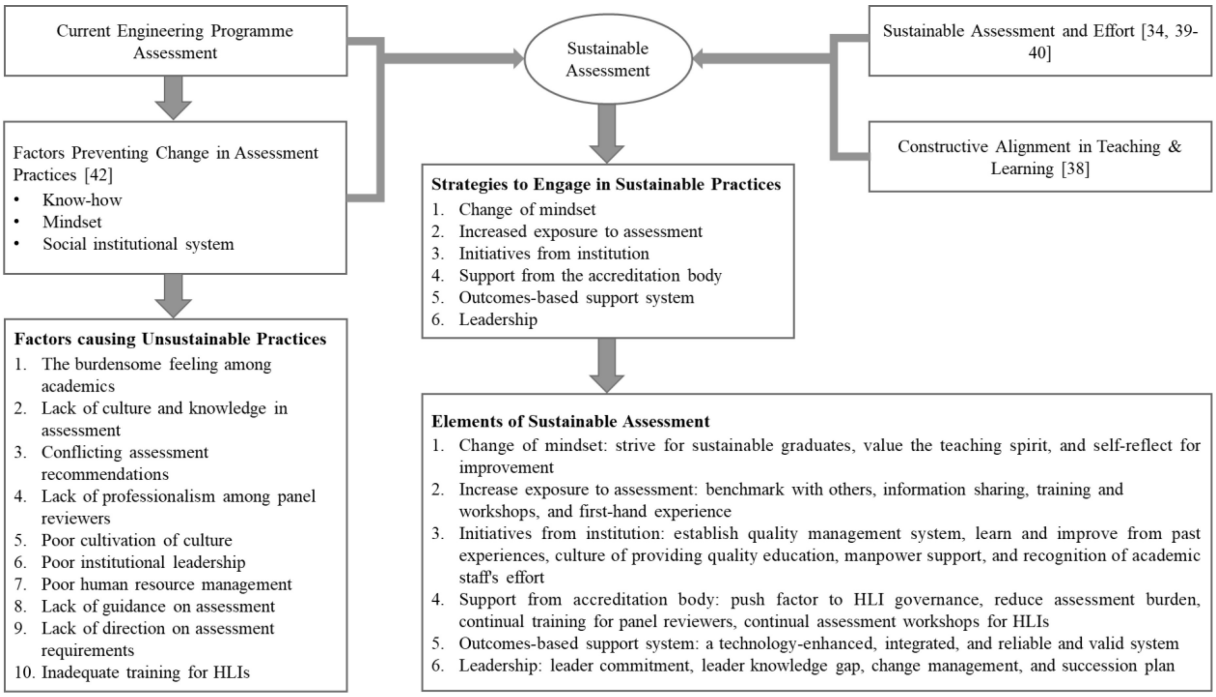

Fig. 3. Mapping the findings to the conceptual framework.

which respond to the research questions and the conceptual framework presented in Fig. 1.

Biggs [42] originally identified three main factors preventing a change in assessment practice: know-how, mindset, and social institutional system. However, the present research has refined these factors. The findings have revealed that the factors contributing to unsustainable assessment practices in Malaysian HLIs can be grouped into two categories: academic staff issues and social-institutional concerns, including panel reviewers, institutional governance, and accreditation bodies. In total, ten factors have been identified as hindering sustainable assessment practices. To address the current issues in assessing engineering programme outcomes, the present research has proposed six strategies for engaging in sustainable assessment practices, drawing inspiration from Brundtland [36] and Biggs [38]. As a result, six elements of sustainable assessment have been identified, which HLIs can adopt to improve the assessment process.

Overall, the research findings offer valuable insights into the factors affecting sustainable assessment practices in engineering programmes. By redefining and regrouping these factors, the present research has paved the way for a more comprehensive understanding of the challenges and potential solutions in Malaysian HLIs. The proposed strategies and elements provide practical guidance for institutions to enhance their assessment practices and move towards sustainability in their engineering programmes.

4. Conclusion and Implications

To ensure graduates are employable and equipped with the skills needed to succeed as professional engineers, top management must prioritise outcome assessment. Currently, programme outcomes assessment is conducted periodically when accreditation is required. However, the objective should shift from merely prioritising accreditation to producing graduates of the highest calibre. This transition necessitates a crucial role for top management. Unfortunately, some leaders were found to be neglecting their duties in advancing programme outcomes assessment requirements. To address this, leaders must possess in-depth knowledge of the assessment processes to avoid overlooking essential elements that could jeopardize the quality of graduates. To encourage outcome assessment champions within the institution, a plan could be devised that includes rewards or promotions for those who excel in this area. Moreover, management must establish a framework that prioritises outcome assessment and ensures continuity through a long-term succession plan. Knowledge transfer from former leaders to potential successors must be considered in this approach.

The research findings underscore the significance of a technology-enhanced system as a criterion for sustainability assessment. Such a system should seamlessly incorporate programme outcomes assessment and evaluation into the HLI's existing

systems, including institutional administrative reports and records. By streamlining assessment processes within the existing systems, academic staff can be relieved of manual labour, making them more willing to engage in outcome assessment activities. Leaders must actively promote the development and implementation of this technology-enhanced system to maximize its benefits.

Accreditation bodies are also accountable for the assessment workload imposed on HLIs and should facilitate sustainable assessment practices. They could reflect on their actions, evaluate their processes and practices, and provide transparent assessment guidelines for HLIs. Making their assessment criteria apparent by organising training or workshops on the assessment of programme outcomes and assessment requirements will save time and effort for academic staff. These initiatives will equip academic staff with the necessary knowledge and skills, enhancing their ability to engage effectively in the assessment process.

In conclusion, the primary goal of the research was to identify sustainable assessment practices for engineering programme outcomes. The proposed framework outlines elements to alleviate the burden on academic staff, ultimately leading to a more effective teaching and learning process. By adopting the suggested sustainable practices and comparing outcomes with current practices, the framework's practicality can be assessed and improved, ensuring continuous enhancement of engineering programme outcomes assessment.

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