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Bridging Accreditation and SDGs through Outcome-Based Education: Pathways for Transforming Engineering Curricula

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ABSTRACT

The convergence of global sustainability challenges and the Fourth Industrial Revolution (IR 4.0) has amplified the need for transformative approaches in engineering education and accreditation. This paper explores how the newly launched Engineering Accreditation Standard 2024 (EAC2024) by the Board of Engineers Malaysia (BEM) serves as a strategic platform to embed both the Sustainable Development Goals (SDGs) and Environmental, Social, and Governance (ESG) values into engineering curricula through Outcome-Based Education (OBE). ESG, a framework widely adopted in the corporate and policy world, emphasises responsible environmental stewardship, social inclusivity, and strong governance—values that are increasingly vital in engineering practice. Through constructive alignment and gap analysis, this paper illustrates how EAC2024's 11 Graduate Attributes map directly to SDG and ESG-aligned competencies, such as sustainable design (PO3), global and societal impact (PO6), ethical practice (PO7), and lifelong learning (PO11). Besides, the paper discussed the implementation pathways including curriculum reform, authentic and inclusive assessments, stakeholder engagement, and integration of Generative AI. Case studies from Malaysia such as Service Learning Malaysia-University for Society (SULAM) and capstone projects, demonstrate real-world alignment. Ultimately, accreditation is positioned as a catalyst for producing engineers ready to lead in building a sustainable, inclusive, and ethically grounded future.

Keywords: EAC Standard 2024, Engineering Education and Accreditation, Environmental, Social and Governance, Outcome-Based Education, Sustainable Development Goals

1. INTRODUCTION

The 21st century has brought forth unprecedented challenges for humanity, ranging from climate change, social inequality, and environmental degradation to rapid technological shifts brought by the Fourth Industrial Revolution (IR 4.0) [1]. These complex, interconnected issues have redefined the role of engineers in society and demand a transformative shift in how engineering education is designed, delivered, and evaluated. Traditional models focused primarily on technical competency are no longer sufficient; instead, there is an urgent need to cultivate engineers who are sustainability-conscious, socially responsible, ethically grounded, and future-ready. At the global level, frameworks such as the United Nations Sustainable Development Goals (SDGs) and the Environmental, Social, and Governance (ESG) agenda have been introduced as guiding principles for systemic change in education, economy, and governance. In parallel, educational frameworks such as Outcome-based Education (OBE) have emerged as powerful pedagogical models for aligning learning with desired graduate capabilities. In the context of engineering education, accreditation standards rooted in OBE serve as quality assurance mechanisms that can be leveraged to systematically integrate these global aspirations into curriculum design and delivery [2].

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In response to these evolving needs, the Engineering Accreditation Council (EAC) under the Board of Engineers Malaysia (BEM) has continuously enhanced its framework and has now launched the new Engineering Accreditation Standard 2024 [3].

The revised standard features 11 updated Programme Outcomes (Graduate Attributes) that reflect international benchmarks under the Washington Accord and prioritise critical areas such as sustainability (PO3, PO6), ethics (PO7), teamwork (PO8), and lifelong learning (PO11). This provides a timely and strategic opportunity for engineering programmes in Malaysia to operationalise the integration of SDG targets and ESG dimensions into engineering curricula. In the EAC2024 context, constructive alignment must extend beyond cognitive skills to include affective and ethical elements aligned with SDG and ESG values. Meanwhile, gap analysis plays a critical role in diagnosing misalignments between current practices and the desired outcomes prescribed by EAC2024, the SDGs, and ESG indicators. By systematically identifying what is missing or misaligned, whether in course content, delivery methods, assessment strategies, or stakeholder engagement, where academic programmes can implement targeted interventions that promote Continual Quality Improvement (CQI). This paper proposes a comprehensive framework that integrates the SDGs and ESG principles into engineering curricula through the lens of OBE guided by the EAC2024 standard. It discusses the theoretical foundations, practical pathways for implementation, and selected best practices, both local and international, that illustrate how constructive alignment and gap analysis can drive meaningful curriculum transformation. Ultimately, it positions accreditation not merely as a compliance tool but as a catalyst for nurturing engineers who are capable of addressing societal and planetary challenges with innovation, integrity, and impact.

2. LITERATURE REVIEW

2.1 Outcome-Based Education and Constructive Alignment in Engineering

Outcome-based education or known as OBE is defined as a student-centred approach that clearly focuses on the outcomes of learning, ensuring that all curriculum elements: objectives, content, instruction, and assessment are aligned to facilitate meaningful learning [4]. In engineering education, OBE has been globally accepted through international accords such as the Washington Accord, which mandates that graduates demonstrate a range of competencies from technical knowledge to ethical practice and sustainability awareness. In the context of engineering accreditation, constructive alignment ensures that Programme Educational Objectives (PEOs), POs and Course Outcomes (COs) are interlinked and traceable through authentic assessment strategies. constructive alignment has been instrumental in enhancing student engagement and learning quality in engineering faculties across Southeast Asia [5].

2.2 Accreditation as a Quality Assurance and Transformation Mechanism

Accreditation frameworks play a dual role in engineering education in providing quality assurance while also driving curriculum reform. Malaysia's EAC has emphasised the alignment of engineering graduate attributes with broader societal needs through its updated EAC2024 Standard. The 11 Graduate Attributes now include sustainability (PO3, PO6), ethics (PO7), and global awareness (PO6), making explicit references to global development challenges. These trends reflect a shift from technocentric engineering education to one that prioritises social responsibility, stakeholder engagement, and interdisciplinary learning.

2.3 Embedding Sustainable Development Goals (SDGs) into Engineering Education

The United Nations SDGs provide a universal framework for addressing global challenges such as poverty, inequality, climate change, and access to quality education. Engineering has a direct and profound impact on achieving these goals, particularly SDG 6 (Clean Water), SDG 9 (Industry, Innovation, Infrastructure), SDG 11 (Sustainable Cities), SDG 12 (Responsible Consumption), and SDG 13 (Climate Action). It was argued that sustainability literacy must be embedded across the entire engineering curriculum and not only in elective or capstone courses [6]. Similarly, Similarly, it was suggested that SDGs should not be seen as peripheral but integral to programme design, including assessments and teaching strategies [7]. The challenge, however, lies in the operationalisation of these goals into measurable learning outcomes, which frameworks such as constructive alignment and accreditation standards like EAC2024 are well-positioned to address.

2.4 Environmental, Social, and Governance (ESG) in Higher Education

ESG criteria are increasingly used by employers, investors, and institutions to assess sustainability and ethical practices. In the context of higher education, ESG provides a complementary framework to the SDGs for guiding curriculum development, stakeholder reporting, and graduate employability. It was found that some universities that embed ESG principles into their academic programmes produce graduates who are more likely to become ethical leaders and responsible innovators [8]. Integrating ESG into engineering education also ensures that students are exposed to the ethical and governance dimensions of engineering practice, particularly in areas such as compliance, risk management, and environmental responsibility [9].

3. THE ENGINEERING ACCREDITATION STANDARD 2024 (EAC2024)

The Engineering Accreditation Standard 2024 (EAC2024), published by the Engineering Accreditation Council (EAC) under the Board of Engineers Malaysia (BEM), represents a significant evolution in Malaysia's engineering education landscape. The new standard consolidates the 12 graduate attributes into 11 by combining "The Engineer and Society (PO6)" and "Environment and Sustainability (PO7)" under the new heading "The Engineers and the World (PO6)." Furthermore, the EAC2024 emphasises critical thinking, innovation, emerging technologies, and lifelong learning (PO11), as well as knowledge and awareness of ethics, diversity, and inclusion (PO7) (Board of Engineers Malaysia, 2024). Therefore, it reaffirms Malaysia's commitment to global standards under the Washington Accord while simultaneously responding to national and global imperatives such as the SDGs and the ESG agenda. The revised standard strengthens the foundation of OBE and introduces explicit emphasis on sustainability, ethics, and societal impact, providing an enabling framework for curriculum transformation across accredited programmes.

3.1 Key Features of EAC2024

At the heart of EAC2024 are 11 Graduate Attributes (POs) which reflect the expected capabilities of engineering graduates. From the EAC2024, requires the inclusion of POs related to the environment (PO3, PO6), social responsibility (PO6, PO8), and governance and ethics (PO7, PO10) provides direct entry points for embedding ESG principles into the curriculum. These alignments empower institutions to map SDG targets to specific learning outcomes, assessments, and graduate attributes. These outcomes are designed to ensure that graduates are not only technically proficient but also socially responsible, environmentally conscious, and professionally ethical. Table 1 shows the suggested close related PO to ESG/SDG. The revised outcomes emphasise holistic education, systems thinking, and real-world problem-solving.

Table 1 Programme Outcome with the ESG/SDG Alignment

PO	Programme Outcome	ESG/SDG Alignment
PO1	Engineering Knowledge	SDG 4, 9
PO2	Problem Analysis	SDG 6, 9, 13
PO3	Design/Development of Solutions	E (Environmental) – SDG 9, 11, 12, 13
PO4	Investigation	SDG 9, 13
PO5	Modern Tool Usage	SDG 4, 9
PO6	The Engineer and the World (impact on society, economy, health, safety, environment)	E/S/G – SDG 3, 10, 13, 16
PO7	Ethics	G (Governance) – SDG 5, 10, 16
PO8	Individual and Team Work	S (Social) – SDG 5, 8, 17
PO9	Communication	SDG 4, 17
PO10	Project Management and Finance	SDG 8, 9, 12
PO11	Life-long Learning	SDG 4, 8, 9

Note: SDG 1 – No Poverty, SDG 2 – Zero Hunger, SDG 3 – Good Health and Well-being, SDG 4 – Quality Education, SDG 5 – Gender Equality, SDG 6 – Clean Water and Sanitation, SDG 7 – Affordable and Clean Energy, SDG 8 – Decent Work and Economic Growth, SDG 9 – Industry, Innovation and Infrastructure, SDG 10 – Reduced Inequalities, SDG 11 – Sustainable Cities and Communities, SDG 12 – Responsible Consumption and Production, SDG 13 – Climate Action, SDG 14 – Life Below Water, SDG 15 – Life on Land, SDG 16 – Peace, Justice and Strong Institutions, SDG 17 – Partnerships for the Goals, E-Environmental, S- Social , G- Governance.

3.1.1 Constructive Alignment within EAC Standard 2024 (EAC2024)

Constructive alignment plays a pivotal role in enhancing student learning by ensuring coherence between learning outcomes, teaching activities, and assessment tasks. A constructive alignment is essential for achieving the targeted programme outcomes through integrated curriculum design [10]. However, despite its benefits, the effective implementation of constructive alignment remains a challenge in engineering education. It was indicated that engineering courses that embed programme outcomes often struggle to align curricular components with institutional vision and performance indicators [11].

Constructive alignment is fundamentally the alignment between learning outcomes, instructional methods, and assessment tasks. Figure 1 illustrates the principle of constructive alignment, showing the connection between three main components: Learning Outcomes, Instructional Methods, and Assessment Strategies.

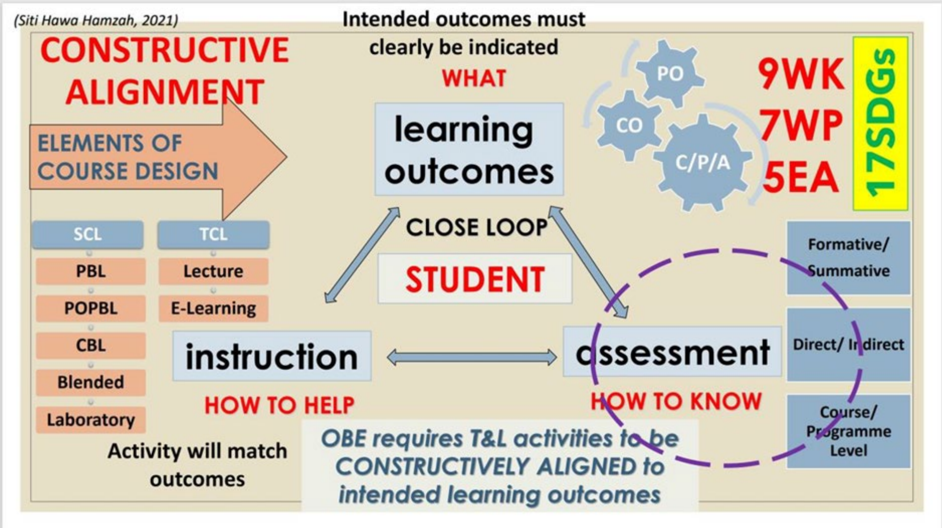

Figure 1. Constructive alignment Principle between Learning Outcomes, Instructional Methods and Assessment [12].

Yet, its application faces numerous challenges, including pedagogical limitations, policy enactment barriers, and institutional resistance [13]. There were issues of underdeveloped quality assurance practices and the need for a supportive academic culture to sustain alignment practices. The EAC2024 explicitly reinforces the principle of constructive alignment to ensure that engineering graduates meet global standards of competence and sustainability. Thus, the EAC2024 emphasises a systematic alignment between PEOs, POs and COs, teaching, learning and assessments (TLA) methods. The framework is grounded in the belief that students learn most effectively when instruction and assessment are intentionally aligned with expected outcomes.

Engineering programmes are designed with clearly defined PEOs that describe what graduates are expected to achieve a few years after graduation. In accordance with the EAC2024, PEOs must reflect the needs of key stakeholders, align with the institutional mission, and be responsive to societal priorities, especially those linked to the United Nations SDGs. To operationalise these objectives, programmes define POs, the specific knowledge, skills, and attitudes that students are expected to attain by the time of graduation. These POs are mapped to the Washington Accord Graduate Attributes, which emphasise competencies such as engineering knowledge, problem analysis, solution design, ethical responsibility, sustainability, and lifelong learning. These outcomes also align closely with ESG dimensions and relevant SDG targets.

Constructive alignment requires that COs be purposefully designed to support the achievement of the respective POs. Each CO must clearly articulate what students should be able to demonstrate upon completing the course, and must be measurable, relevant, and aligned with both POs, ESG and SDG goals. To achieve these outcomes, TLAs must be carefully selected and constructively aligned. Passive lectures should be complemented or replaced by case studies, laboratory work, and simulation projects that foster critical thinking and data interpretation. Such active strategies allow students to apply knowledge in realistic settings. Equally important is assessment design, which must evaluate not only technical proficiency but also ethical reasoning, environmental awareness, and problem-solving. Embedding authentic tasks, holistic criteria, and transparent rubrics ensures assessments reinforce intended outcomes. This approach develops graduates who are technically competent and prepared to address complex societal, environmental, and governance challenges in line with ESG and SDG imperatives.

3.2 Gap Analysis and Continual Quality Improvement (CQI) for EAC2024 Compliance

Gap analysis is a strategic assessment process used to evaluate the discrepancies between the current Engineering Accreditation Standard 2020 and the newly launched EAC2024. It plays a critical role in preparing engineering programmes for compliance by identifying what must be enhanced, introduced, or realigned in the curriculum, teaching practices, and quality systems. A key area where gap analysis must be emphasised is within the curriculum. This can be achieved through updated project-based learning, authentic assessment, and student portfolios that clearly reflect compliance with the expectations of the new standard [14]. For example, areas such as public safety and sustainable development, which are given heightened importance in EAC2024, may require curricular remapping, either by embedding new topics or enhancing existing content to ensure they align with the SDG and ESG goals. The process typically begins with a systematic evaluation of each accreditation criterion: PEOs, OBE design, academic curriculum, student learning support, academic and support staff, facilities, and Quality Management System (QMS). The programme should carefully identify specific gaps where enhancements are needed to meet the EAC2024, supported by clear documentation and stakeholder engagement.

Importantly, the principle of constructive alignment must underpin the gap analysis. During the planning stage, this includes reviewing and redesigning the syllabus, learning outcomes, and lesson plans. In the implementation stage, emphasis must be placed on delivery strategies, assessment tasks, and feedback mechanisms. Alignment between COs and TLA activities ensures that students are given adequate opportunities to attain the intended learning outcomes. Through a well-executed gap analysis strategy, higher education institutions can identify strengths, address deficiencies, and apply targeted interventions. This enables engineering programmes to remain agile, future-ready, and aligned with national priorities, international benchmarks, and global sustainability imperatives.

3.3 Enabling ESG and SDG Integration through Accreditation

Higher education frameworks worldwide are increasingly emphasising the integration of ESG principles and the United Nations SDGs. Embedding these elements within curricula allows institutions to align educational quality with global development imperatives and national sustainability agendas. The incorporation of ESG in engineering education signifies a strategic shift from traditional focuses on technical performance and economic efficiency toward a broader emphasis on sustainability, ethical responsibility, and long-term environmental stewardship. As This holistic approach encourages the evaluation of environmental impacts alongside societal needs and governance practices [15]. Under the EAC2024, engineering programmes are now required to ensure constructive alignment between PEOs, POs and COs. This alignment is expected to integrate sustainability and social responsibility across the curriculum. For instance, courses in environmental engineering can demonstrate how COs support PO6 (The Engineer and the World), directly contributing to SDG 13 (Climate Action) and SDG 11 (Sustainable Cities and Communities). The combination of ESG and SDG elements elevates accreditation from a mere compliance mechanism to a value-driven transformation tool. This fosters the following impacts:

3.3.1 Enhancing Graduate Employability in ESG-Focused Industries

Integrating ESG and SDG principles into accreditation frameworks enhances graduate employability, especially in industries prioritising sustainability. With growing demand for professionals capable of addressing climate change, renewable energy, ethical governance, social impact, and responsible consumption, graduates must demonstrate competencies aligned with POs that highlight ethics, sustainability, and lifelong learning (e.g., PO6, PO7, PO11).

3.3.2 Fostering University–Industry–Community Collaboration

Strong stakeholder engagement, particularly through Industrial Advisory Panels (IAPs) and industry collaborations, creates impactful opportunities for sustainability-focused projects. For example, collaborations on flood mitigation projects allow students to apply engineering knowledge to real-world problems, contributing to SDG 11. Community-based service-learning (e.g., SULAM) projects—such as designing low-cost water filters for rural populations, promote SDG 3 (Good Health and Well-being) and instil social responsibility and civic-mindedness among engineering graduates.

3.3.3 Contributing to National and Global Sustainability Goals

The integration of ESG and SDG frameworks is closely aligned with national strategies such as the Twelfth Malaysia Plan (12MP), which emphasises sustainability, digital transformation, and inclusive growth. Initiatives such as carbon emission tracking, gender equity in engineering education, and innovation in green technologies reinforce institutional accountability to both national targets and the UN 2030 Agenda for Sustainable Development.

4. IMPLEMENTATION PATHWAYS

The EAC2024 emphasises constructive alignment, sustainability integration, and CQI. Embedding ESG and SDG principles into engineering education thus requires systemic transformation across curriculum design, delivery, assessment, and institutional culture. Four strategic implementation pathways are outlined:

4.1 Curriculum Reform and Mapping

Curriculum reform is foundational for embedding sustainability and ESG principles. Programmes must be intentionally designed to ensure POs and COs are aligned with graduate attributes and mapped to specific SDG targets and ESG dimensions. Some key steps in curriculum reform are:

1. **Gap Analysis:** Begin with a systematic review of existing COs and POs to identify where sustainability, ethics, or social governance elements are underrepresented. For example, limited emphasis on environmental governance or interdisciplinary applications can highlight areas for improvement.

2. **Embedding Interdisciplinary and Transdisciplinary Content:** Courses such as engineering economics, environmental policy, and sustainable development should expose students to broader socio-technical systems and cultivate systems thinking. For example, a power systems course can integrate content on energy policy and community acceptance to complement technical learning.

3. **Introducing New Courses or Modules:** New courses on green engineering, ESG practices, and global sustainability can strengthen students' specialized skills and ethical awareness.

4. **Integrating Grand Challenges and SDG Themes Across the Curriculum**: Sustainability themes should be embedded horizontally (across disciplines) and vertically (across years). For instance, introducing SDG challenges (e.g., smart cities, poverty, water security) in foundational and advanced subjects fosters repeated exposure and deeper understanding.

4.2 Teaching and Learning Strategies

To cultivate SDG-aligned graduate attributes, T&L methods must move from lecture-centric to learner-centered approaches that promote critical thinking, ethics, and real-world application. Some recommended pedagogical approaches are:

1. **SULAM (Service Learning Malaysia – University for Society):** Involves students in community-based projects such as low-cost water filters or air/noise quality assessments. These address real community needs and align with SDG 3 (Good Health and Well-being), while fostering social responsibility.

2. **Project-Based Learning (PjBL) and Problem-Based Learning (PBL):** These approaches allow students to solve complex engineering problems while considering sustainability and stakeholder contexts. For instance, a project to design wastewater systems using national standards, combined with sustainability evaluation, integrates PO3, PO6, and SDG 6.

4.2.1 Assessment Innovation

In the context of embedding the ESG and the SDGs, assessment cannot remain confined to traditional examinations or rote knowledge testing. The assessment methods must evaluate higher-order thinking, systems thinking, ethical judgment, and interdisciplinary collaboration, skills and values that are essential for graduates to address complex, real-world challenges. There are a few strategies such as;

1. Designing rubrics aligned with PO–SDG–ESG frameworks, emphasising ethical reasoning, environmental impact, and stakeholder inclusivity. The rubric should be transparent and ensure that assessment criteria are aligned with the POs, as well as SDGs and ESG principles.
2. Portfolio-based assessments that provides a comprehensive, longitudinal record of learning and mapped to POs, SDGs, and ESG indicator.
3. Reflective assessments are students critically analyze their own experiences, decisions, and learning journey, and abilities to demonstrate ethical reasoning, sustainability awareness, and lifelong learning;
4. Stakeholder assessments to validate the relevance and real-world applicability of graduates' competencies and align with industry needs, societal expectations, and sustainability goals.

4.2.2 Faculty Development and Institutional Support

The integration of ESG and SDGs in engineering education cannot rely on curriculum reform or assessment innovation alone. Strong support from faculty, heads of departments, and institutions is essential to translate programme outcomes into meaningful teaching, learning, and assessment. Institutional backing through policies, resources, incentives, and culture is critical to sustain this transformation. Key supports include:

1. Professional development – workshops on constructive alignment, SDG pedagogy, ESG integration, and assessment design (e.g., rubrics for sustainability trade-offs), equipping academics to produce globally relevant and ethically grounded graduates.
2. Communities of Practice (CoP) – peer platforms for sharing innovations, best practices, and lessons learned in embedding SDGs into COs, POs, and TLAs, and for co-developing teaching materials, case studies, and rubrics.
3. Policy alignment – embedding sustainability and ethics in programme design, delivery, and assessment consistent with EAC2024, SDGs, and ESG commitments.

4.2.3 Stakeholder Engagement and Co-Creation

It requires collaborative partnerships between academia, industry, policymakers, and communities to ensure that programmes remain relevant, future-oriented, and impactful. Under EAC2024 is a core requirement that influences curriculum reform, teaching and learning, assessment, and institutional transformation. For example, on the project a water sustainability module was co-created with the Department of Environment and a local NGO. Students were engaged in doing the fieldwork on water quality monitoring, designing low-cost treatment systems for rural communities and conducting reflective assessment on the social and ethical dimensions of water access. This project is aligned with SDG 6 (Clean Water and Sanitation) and SDG 11 (Sustainable Cities and Communities) while producing measurable community benefits and accreditation evidence. Together, these implementation pathways offer a systemic and adaptable framework for embedding sustainability, ethics, and global responsibility within engineering education. Through the lens of constructive alignment and gap analysis, institutions can move beyond compliance toward transformative impact, ensuring that graduates are ready to lead with competence, conscience, and commitment to a better world.

5. CASE STUDIES AND BEST PRACTICES

Successful implementation of sustainability and ESG principles in engineering education requires real-world application through programmes, community engagement, and curriculum design. This section presents a Malaysian case study from the civil engineering curriculum at Universiti Teknologi MARA (UiTM) Shah Alam, showing how programme outcomes are aligned with SDGs, ESG dimensions, and OBE frameworks.

Case Study 1: Engineers in Society Course

UiTM's Engineers in Society course demonstrates how SDG-aligned outcomes, constructive alignment, and community-based education can be embedded in engineering curricula. Anchored in Design Thinking and Service-Learning Malaysia- University for Society (SULAM), it immerses students in authentic problem-solving and sustainable engineering. Guided by the CDIO framework, students collaborate with communities and stakeholders to address societal, environmental, economic, cultural, safety, and health issues. Under SDG 3 (Good Health and Well-Being), projects include rural noise and air quality assessments and low-cost water purification systems. For SDG 4 (Quality Education), students partner with underserved schools and groups to deliver awareness programmes on water conservation, ecology, and waste recycling. In line with SDG 11 (Sustainable Cities and Communities), initiatives include rainwater harvesting, timber housing for *orang asli*, and community-based waste segregation. Figure 2 illustrates examples of local and international SULAM projects.

The course also demonstrates strong ESG integration. On the Environmental (E) dimension, student projects emphasise green infrastructure, sustainable waste management, and eco-friendly materials. On the Social (S) dimension, students engage with marginalised groups such as rural communities, schools, orphanages and NGOs through safety, health and environmental awareness programmes, and social innovation projects. On the Governance (G) dimension, students are trained to uphold ethics, leadership values, and professional responsibilities, incorporating stakeholder consultation to ensure inclusivity and accountability. A series of webinars broadened students' perspectives on governance, covering occupational safety and health, roles of professional bodies, and relevant regulations and standards. Assessment is carried out through assignment, group project, and video presentation that assessed on the objectives of the community-based project and challenges faced and comprehension on the engineers' role and demonstration of professional ethics which, aligned with graduate attributes such as PO6 (The Engineer and the World) and PO7 (Ethics).

Figure 2. SULAM projects: Rural empowerment and community project at Kuala Terengganu (left) and Assessment of noise and air quality in Indonesia (right).

Case Study 2: Integrated Design Project Course

The Integrated Design Project (IDP) serves as a capstone platform for students to integrate civil engineering knowledge, skills, and professional values in solving complex engineering problems. Structured into a group-based capstone project and a case study project, the course emphasises sustainability and governance while requiring students to design solutions that address technical, environmental, social, cultural, economic, health, and safety dimensions. Industry practitioners and professional engineers contribute through talks and the evaluation of student presentations (Figure 3). The IDP capstone immerses students in a consultancy-style exercise addressing real building and infrastructure challenges for earthworks, drainage, water supply, sewerage, and road systems in development projects, ensuring accessibility, safety, reliability, and resilience. These efforts advance SDG 6 (Clean Water and Sanitation), SDG 9 (Industry, Innovation and Infrastructure), and SDG 11 (Sustainable Cities and Communities). Alongside technical design, students undertake costing, feasibility analysis, and construction scheduling, reinforcing SDG 8 (Decent Work and Economic Growth). This collaborative model reflects SDG 17 (Partnerships for the Goals). The case study component deepens students' critical evaluation of sustainability, health, safety, and cultural issues while aligning with SDG 12 (Responsible Consumption and Production).

Figure 3. IDP learning activities: Industrial talks (left); presentation and evaluation of capstone project involving invited professional engineer (right).

The course also demonstrates robust ESG integration. On the Environmental (E) dimension, students apply carbon footprint estimation and green design principles. On the Social (S) dimension, the course embeds health, safety, and well-being. On the Governance (G) dimension, students practice project management, compliance with codes, and ethical accountability. Assessment in the IDP is rubric-based, addressing graduate Attributes comprehensively, including PO1 (Engineering Knowledge), PO3 (Design and Development of Solutions), PO6 (The Engineer and the World), PO8 (Individual and Collaborative Teamwork), and PO10 (Project Management and Finance).

Case Study 3: Course Final Year Projects (FYP)

Final Year Projects (FYPs) are two-semester, individual research-based projects that integrate complex engineering problem-solving with investigation, research ethics, and sustainability. Students independently define problems, formulate hypotheses, and design methods demonstrating technical rigour, originality, environmental stewardship, and societal impact. In FYP 1, students scope problems and conduct systematic reviews, then justify methodology (experimental, simulation, analytical, survey, or mixed methods) by selecting appropriate tools. In FYP 2, they execute research and undertake rigorous analysis while prioritising environmental, safety, and responsible practices (advancing SDGs 6, 7, 9, 13). Project management embeds milestone planning, budgeting, and resourcing, cultivating awareness of economic viability and governance (SDG 8). Throughout, students disseminate findings via reports, seminars, posters, and viva sessions to academic and industrial panels, ensuring relevance, ethics, and impact. Aligned to the SDGs, exemplar topics include: safety plans for construction (SDG 3); wastewater treatment (SDG 6); job employment (SDG 8); innovative concrete using waste (SDG 9); flood-risk modelling (SDG 11); embodied-carbon assessment (SDG 13); stormwater treatment (SDG 14); and nature-based slope-stabilisation (SDG 15).

ESG integration is explicit. On the Environmental (E) dimension, students conduct green experimentation and waste management. On the Social (S) dimension, they propose health and safety protocols and socially relevant research. On Governance (G), they practice ethics compliance, data integrity, and adherence to professional standards. Rubric-based assessment evaluates problem framing, methodological rigour, tool usage, technical depth, environmental and social impact, and ethically accountable research management aligned with PO2 (Problem Analysis), PO4 (Investigations), PO5 (Tool Usage), PO7 (Ethics), PO9 (Communications), and PO11 (Lifelong Learning).Across the three case studies, constructive alignment that links course outcomes, programme outcomes, the SDGs, and environmental, social, and governance dimensions creates curricular coherence so teaching activities, assessments, and evidence of learning move in one direction.

6. WAY FORWARD

The integration of the EAC2024 Graduate Attributes, SDGs, and ESG principles into engineering curricula presents a significant opportunity for transformative education. However, the shift from traditional techno-centric models to holistic, sustainability-driven engineering education is not without its challenges. These challenges must be critically addressed to fully realise the benefits of the EAC2024 framework and global development agendas. Besides, the implementation of the Engineering Accreditation Standard 2024 (EAC2024) marks a strategic turning point in Malaysia's engineering education landscape. It provides a timely and powerful platform to integrate the SDGs and ESG dimensions into curricula, pedagogy, and assessment practices through OBE. To fully realize its transformative potential, the engineering education ecosystem must adopt a coherent, collaborative, and future-oriented strategy.

7. CONCLUSION

The convergence of the Engineering Accreditation Standard 2024 (EAC2024), the SDGs and the ESG agenda presents a powerful opportunity to redefine engineering education in Malaysia and beyond. As this paper has demonstrated, aligning engineering curricula with EAC2024 through the lens of OBE provides a coherent and strategic platform to embed sustainability, ethics, and social impact across all dimensions of teaching, learning, and assessment. By leveraging constructive alignment, institutions can ensure that PEOs, POs and COs, and assessment strategies work in concert to produce graduates who are not only technically competent but also globally responsible and ethically grounded. Gap analysis, coupled with CQI, ensures that any disconnects between current practices and the aspirations of EAC2024, SDGs, and ESG frameworks are identified and addressed. Real-world examples illustrate the feasibility and value of this integrated approach. Despite challenges such as curriculum inertia, faculty resistance, and assessment complexity, the opportunities are vast. With strong institutional commitment, faculty empowerment, stakeholder engagement, and digital innovation, engineering education can evolve to meet the needs of society and the planet. Ultimately, accreditation must no longer be seen as an administrative requirement, but as a catalyst for transformation. Through the strategic alignment of accreditation, OBE, SDGs, and ESG principles, Malaysia is well-positioned to lead a new paradigm of engineering education; one that nurtures resilient, ethical, and sustainability-driven engineers capable of addressing the grand challenges of our time.

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