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Engineering Education Review

PERSPECTIVE

Quality engineering education through accreditation

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INTRODUCTION

In the midst of a rapidly evolving environmental, socio-economic, and geopolitical landscape marked by the pressing challenges of global warming and crises, the role of engineering education stands out as a pivotal force for sustainable development. Recognizing this pivotal role, engineering educators are faced with the critical task of equipping graduates with a profound understanding of sustainability within the context of their engineering practice. This necessitates a paradigm shift towards results-based education, continuous evaluation, and proactive coordination through life-long learning. As the demand for sustainability in engineering practices intensifies, accreditation bodies, higher education institutions, policy makers, stakeholders, and communities find themselves at a crossroads, compelled to adapt their strategies for engineering education and accreditation. The imperative is clear – aligning educational practices with the ever-changing demands of the contemporary world, emphasizing a comprehensive approach to sustainability. Notably, the Myanmar Engineering Council (MEngC) has emerged as a proactive player in this transformative journey. Hosting the Committee on Education in Engineering (CEIE) of the World Federation of Engineering Organizations (WFEO) since 2019, MEngC has demonstrated its commitment to fostering global collaboration and sharing best practices in engineering education. The establishment of the WFEO Academy and the provision of accreditation mentoring underscore MEngC's dedication to advancing educational quality. Further reinforcing its commitment, MEngC has welcomed another significant institution into its fold-the Engineering Education Accreditation Committee (EEAC). Tasked with overseeing accreditation processes in Myanmar's engineering education landscape, the EEAC aligns its objectives with the ambitious United Nations 2030 Agenda for Sustainable Development Goals (SDGs). This paper aims to delve into the depth and breadth of the journey towards achieving quality engineering education through accreditation in Myanmar. By examining the initiatives of MEngC, the challenges faced, and the milestones achieved, this discussion seeks to contribute valuable insights to the broader discourse on engineering education and its transformative role in the pursuit of sustainable development.

THE NECESSITY OF ACCREDITATION IN ENGINEERING EDUCATION

The 4th Industrial Revolution causes uncertainty in the industry, academia and society as we are uncertain of the future of our jobs and what new disruptive technologies are coming. This pushes the academia to train engineers to be internationally bench-marked, practice without any borders and increase international mobility. The need for international bench-marking through accreditation of engineering education become crucial as engineers trained would be substantial equivalence in quality and standard.

THE IMPORTANCE OF RESULTS-BASED EDUCATION, EVALUATION AND CONSTRUCTIVE COORDINATION

The author would like to highlight very important aspects of engineering accreditation: outcome based

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education and assessment and constructive alignment. It is very important for a professional engineer to be able to handle complex engineering problems with his/her relevant competency and it is imperative for the engineers to pass through the education system with outcome based education and assessment. The curriculum must be designed to fulfill the required competency profile. Globalization and borderless mobility of engineers within the region and the global community present new challenges for the engineering educators. Nowadays, engineers can successfully work not only in their home countries, but also within the region and the world. That is why engineers should not consider boundaries and does collaborations with engineers and industry leaders abroad. All these can start from Outcome based education and assessment.

Engineers have taken leadership role of significant advances in the built environment. But, we could not highlight ourselves about negative impacts of developments such as environmental, health and resources problems. It is essential to have close relationships between engineering institutions, industries and communities. Engineers need to ensure this success for sustainable future. Empowering engineers to engage with their communities requires outcome based education in our engineering education discourse.

Significan development of outcome based education approaches begin in 1960 s by Carroll (1963), Bloom (1968), Spady (1988), among others. William Spady (1994), a leading the Outcome Based Education (OBE), wrote " Outcome-based Education means clearly focusing and organizing everything in an educational system around what is essential for all students to be able to do successfully at the end of their leaning experiences. This means starting with a clear picture of what is important for students to be able to do, then organizing the curriculum, instruction and assessment to make sure this learning ultimately happens."[1] EEAC published "*the Outcome Based Education (OBE) Implementation Guide Book*" in 2020 which is intended to provide the general guidelines for the OBE activities.

OUTCOME-BASED EDUCATION AND ASSESSMENT IN MYANMAR'S ENGINEERING EDUCATION

The Washington Accord Agreement recognises that: "Accreditation of engineering academic programme is a key foundation for the practice of engineering at the professional level in each of the countries or territories covered by the Accord." [1]

The Washington Accord demands two major efforts among its member: (1) improvement of procedure, documentation, criteria; (2) Genuine shift towards OBE in Myanmar Engineering Education System.

Within the Myanmar context, there is a mismatch in the supply and demand of graduates, with employers reporting that graduates do not have sufficient soft skills. As a result, the EEAC has fully adopted OBE approaches in its accreditation criteria, all engineering programmes accredited after 2020 will have to be based on OBE.

MYANMAR'S PROCESS OF OBTAINING ENGINEERING EDUCATION CERTIFICATION AND BECOMING A PROVISIONAL SIGNATORY TO THE "WASHINGTON AGREEMENT"

The journey towards Engineering Education Accreditation in Myanmar started when Myanmar signed the Association of Southeast Asian Nations (ASEAN) Mutual Recognition Agreement on Engineering Services in 2007 which requires ASEAN Chartered Professional Engineer having completed an accredited engineering degree recognized by the professional engineering accreditation body (Figure 1).

Having noticed the importance of accreditation in Engineering Education, Federation of Myanmar Engineering Societies have worked with all three pillars of authority: Executive, Legislative and Judiciary for the emergence of a regulatory and signatory authority for engineering professional assessment and licensing. As a result, the Union Parliament enacted the Myanmar Engineering Council Act in 2013. One of the Council mandates is to set up a professional engineering accreditation body. The first Council was set up in 2014, with EEAC as its accreditation agency. The Council rapidly executed more than a hundred awareness workshops and accreditation training in engineering universities and in 2016, it became a member of Federation of Engineering Institution in the Asia&Pacific (FEIAP) which offered accreditation mentorship. Myanmar achieved Level 2 Compliance with FEIAP Engineering Education Accreditation Guidelines in 2018 and in the same year, became a provisional signatory in the Washington Accord of Engineering Alliance (Figure 2).

In 2019–2020, EEAC accredited a total of 18 programmes as full accredited programmes, with 11 of them being from Yangon Technological University and 7 from Mandalay Technological University. Moving forward, in 2021, EEAC conducted visits to 7 programmes from the Defence Services Technological Academy (DSTA) using the "Hybrid Accreditation" mode. The overall accreditation review process undertaken by EEAC has been completed for a total of 78 programmes, with 25 programmes achieving full

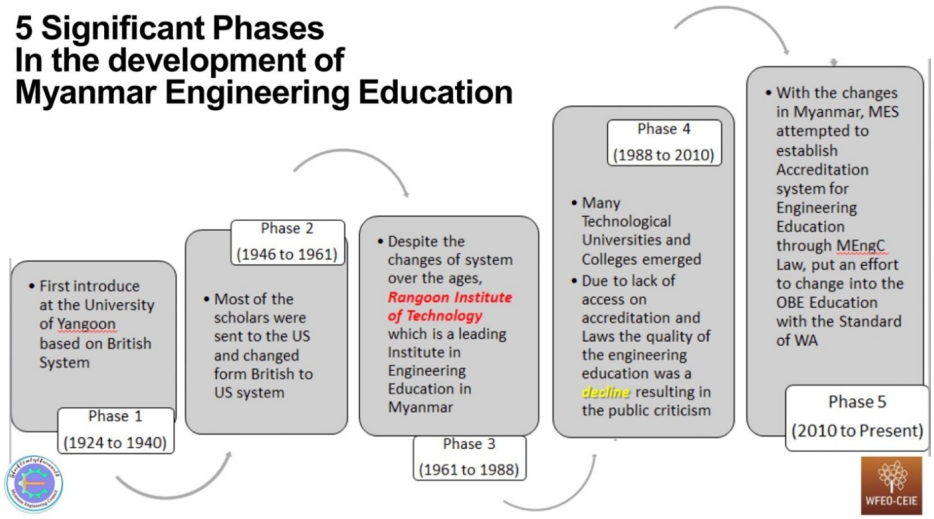

Figure 1. Five Significant Phases in the development of Myanmar Engineering Education.

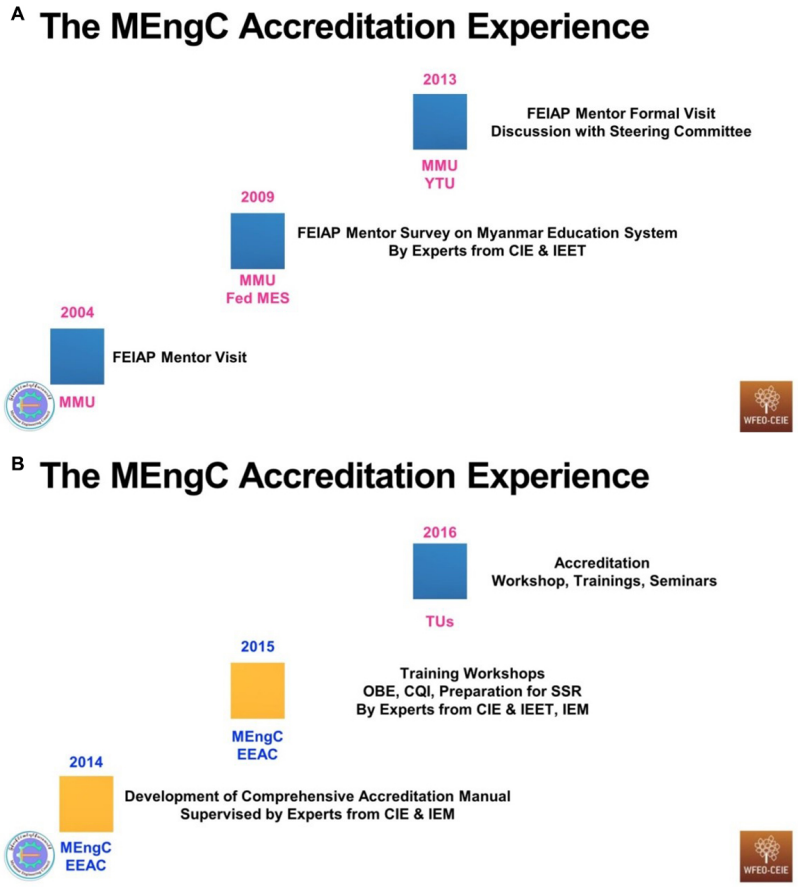

Figure 2. The Myanmar Engineering Council Accreditation Experience. (A) 2004-2013; (B) 2014-2016.

accreditation and another 53 programmes being provisionally accredited. It is intended that in the year 2023, EEAC plan to conduct interim visits to the programmes of Yangon Technological University and Mandalay Technological University.

In 2020, MEngC implemented amendments to the Governing Structure in order to align with the requirements of the International Engineering Alliance (IEA), Washington Accord. These amendments provide the EEAC autonomy to make independent accred-

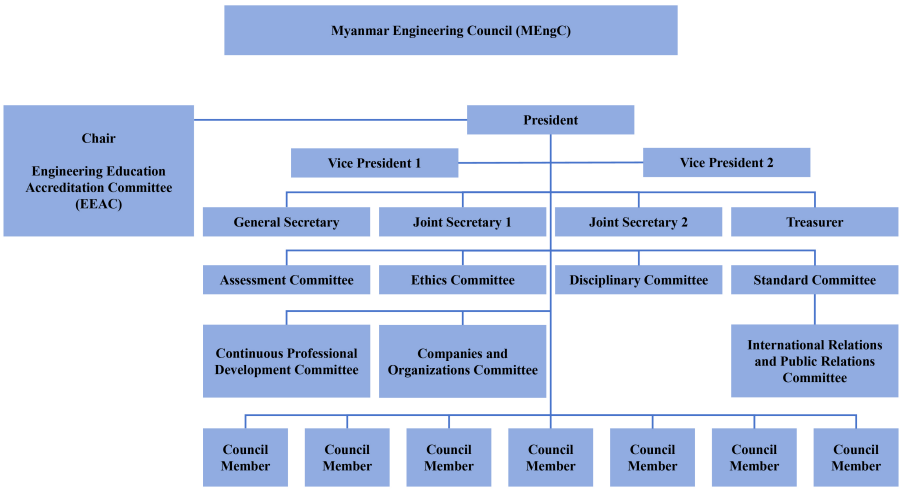

Figure 3. Engineering Education Accreditation Committee (EEAC) as an independent body.

itation-decisions from stakeholder influence. EEAC office is separated from MEngC office organogram and established as an independent body. Presently, EEAC, as the representative of MEngC, is responsible for the purpose of accrediting engineering programs within the Myanmar Engineering Fraternity (Figure 3).

The KG + 12 Education System has been implemented in Myanmar since 2016 in Basic Education System and by 2023 when the first batch of students who have been nurtured under the KG + 12 Basic Education System graduate from High Schools, the existing 6 – year Bachelor of Engineering (B. E.) and Bachelor of Architecture (B. Arch.) programmes will have to be adjusted accordingly and reasonably to be in line with the International Standards such as (4 – 6) System with the total schooling years of at least 16 (Figure 4).

CURRENT ACTIVITIES OF EEAC

EEAC made the amendments to the Accreditation Criteria and Process with the objective of enhancing adherence to the requirements of the Washington Accord Criteria. These amendments involve a comprehensive evaluation of the qualifying requirements for Institutes of Higher Learning (IHLs) and an assessment based on accreditation criteria and procedures.

Tuning criteria and P&P

Gap Analysis

Graduate attributes (GA), Knowledge Profile and Level of Problem Solving processed by EEAC have the substantial equivalence to the WA's.[2]

Fulfillment of Schedule B1

EEAC has been complied with the characteristics of WA Schedule B1 to be accepted as Provisional Member.[3]

Fulfillment of Schedule B2

In order to become full signatory member, EEAC is consistently conforming to the criteria outlined in WA Schedule B2.[4]

Training updates

MEngC had been hosting around more than 60 workshops within previous decade with IEET, APEC, UNSW, IES, IEM, UTS, RMIT, EA, BEM, CIDB and UTS, FEIAP (Figure 5).

Accreditation review Schedule

In 2024, EEAC intend to evaluate the 4 Programmes of Yangon Technological University and Mandalay Technological University with the International Assessors (Figure 6).

EEAC focus on the Action Plan Suggested by our Mentor- Exchanges with Signatories

In the past years, EEAC postponed to invite the Mentors and Observers due to the COVID 19 Pandemic.

In the coming 2023–2024 years, EEAC has been planning to invite the international Observers.

Looking towards to exchanges with signatories, MEngC is hosting the Annual International Conference on Engineering Education Accreditation (ICEEA) presided by World Federation of Engineering Organizations Committee on Education in Engineering (WFEO-CEIE) which catalyzed academia from its international networks to share experience and exchange their good practices and insights from their engineering education

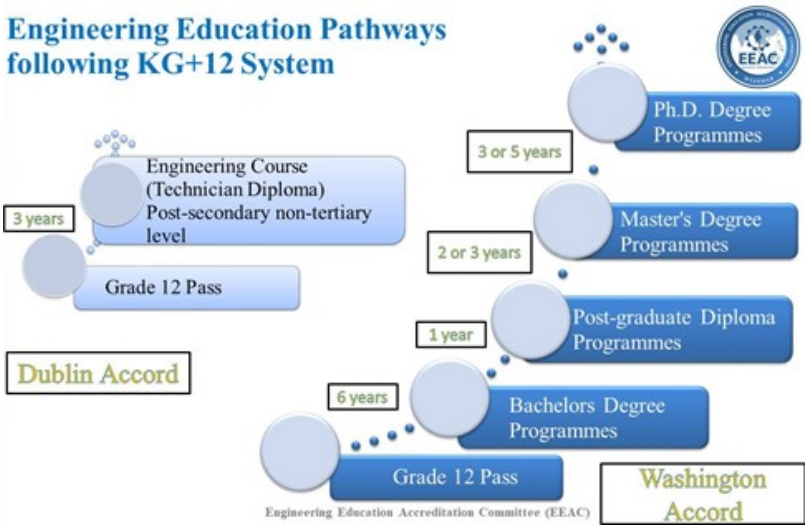

Figure 4. Current Basic Education System in Myanmar.

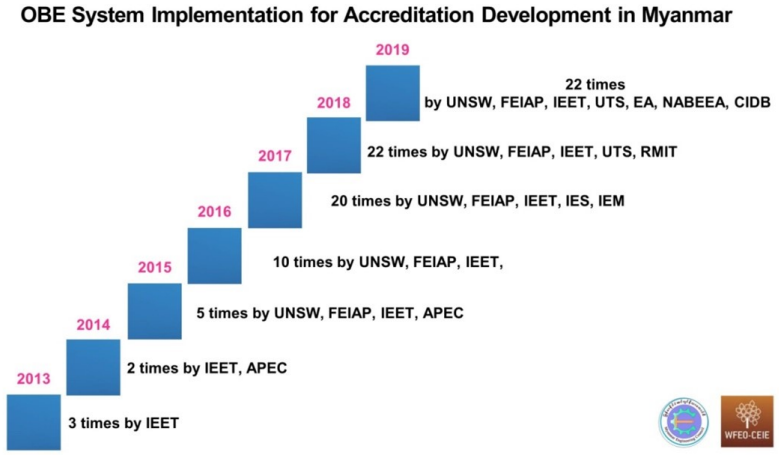

Figure 5. International Trainings for Outcome Based Education System Implementation.

and accreditation practice perspectives.

Online System, Accreditation Management System & Website Development

EEAC is currently developing the Online System Platform for Accreditation Trainings and the Accreditation Management System through the official EEAC website.

We would be highly appreciative of your insights and suggestions that are crucial in helping us further improve our webpage system. (https://myanmarengc-eeac.org/)

EEAC'S PUBLICATIONS

At 2020, EEAC has published the following Accreditation Manuals and Guidelines to assist in the accreditation process for IHLs such as- Guideline to Good Practice: Work-Based Learning,[5] Guideline to Good Practice: Student Assessment,[6] Guideline for Institutional Audit for Convener,[7] Guideline to Good Practice: Curriculum Design and Delivery,[8] Guideline for Programme Accreditation,[9] Manual of the Evaluation Process,[10] Online Training Module (Stage II: Guideline for Programme Evaluator),[11] Programme Accreditation Report (Accreditation/ Re-Accreditation),[12] Guidelines for Observers [13] and Examination Reform Policy,[14] *etc.* During the Holding Provisional Status, EEAC has been submitting the annual reports with regard to the fulfilments of reporting Obligations of WA, IEA.

CONCLUSION

In conclusion, this paper underscores the critical need for engineering education to align with the socio-technical landscape and contribute meaningfully to the fulfillment of the United Nations (UN) Sustainable Development Goals. The imperative is

Accrediting Agency: NEngC/EEAC Contact Person: Dr. Zaw Min Aung, Chair, Engimeering Education Accreditation Committee (EEAC)		Accrediting Agency's self-assessment of substantial equivalence of its standard and the Graduate Attributes and range/level information
Washington Accord Graduate Attribute (WA1-WA12) with supporting knowledge profile statement (WK1-WK8) or level of problem solving (WP1-WP9) (Version3: June 2013)	Elements of Accrediting Agency's Standard corresponding to Graduate Attributes and range/level information	
WA1: Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specifed in WK1 to WK4 respectively to the solution of complex engineering problems. *Where: the knowledge profile elements referred to in this and other attribute statements are:* WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline WK2: Conceptually-based mathematics, mumerical analysis, statistics and formal aspects of computer and information science to support analysis and modelling applicable to the discipline WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline WK4: Engineering specialist knowledge that provides theoretical fameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline. See WA3 for WK5 See WA5 for WK6 See WA6 for WK7 See WA4 for WK8	Criterion 2: Graduate Attributes (GAs) and Assessment (i) Engineering Knowledge-Ability to apply knowledge of mathematics, science, and engineering. Criterion 3: Academic Curriculum The academic programme component must consist of a minimum total 135 SLT credits (not including credits for remedial courses) based on a 14-weeks of teaching semester, made up as follows: (a) A minimum of 80 SLT credits shall be engineering courses consisting of engineering sciences and engineering design/projects appropriate to the student's field of study. (b) The 35 SLT credits shall include suffcient content of mathematics and engineering science component, and 20 SLT credits for complementary studies (such as languages, general studies, co-curriculum, management, law, accountancy, economics, social sciences, *etc.*) that complements the technical contents of the curriculum. EEAC has in Supplement of Accreditation Criteria for Accrediting Engineering Programmes that Integrated Design Project, which is expected to show most of the attributes of IEA complex engineering problem, is stipulated to be the primary assessment tool for programme graduate attributes.	Substantially equivalent

Figure 6. Engineering Education Accreditation Committee (EEAC) Gap Analysis between Graduates attributes.

clear—engineering curricula must transcend conventional boundaries to encompass competencies such as sustainability, social responsibility, equity, and ethics. The trajectory towards producing 21st-century engineers demands a contemporary methodology continuum, a dynamic approach that embraces the evolving attributes required in the field.

The case study on Myanmar's engineering education initiatives, spearheaded by the MEngC) and its accreditation agency (EEAC), illuminates commendable efforts to reshape engineering curricula. The focus extends beyond core and managerial competencies, emphasizing the cultivation of social and sustainable thinking capacities in engineering graduates.

A significant stride is the introduction of OBE guidelines by EEAC, a strategic move that aligns program structures with contemporary pedagogical perspectives. These guidelines offer a comprehensive framework for implementing OBE approaches at various levels, ensuring flexibility to accommodate diverse program requirements and industry strengths. The case studies reveal that the success and sustainability of OBE hinge on the commitment and collaboration among key stakeholders. The guidelines, therefore, should underscore the roles and responsibilities of industry, coaches, tutors, and students to optimize the impact of OBE.

On the global stage, the WFEO-CEIE emerges as a crucial catalyst for networking and knowledge sharing. The Accords and Agreements of the IEA validate accreditation procedures, emphasizing the importance of diversity in meeting rapid changes in the sociological, anthropological, ecological, historical, and cultural landscapes. The disruptions caused by the COVID-19 pandemic underscore the resilience of CEIE in responding to unexpected challenges. Collaborative endeavors through conferences, seminars, and meetings have empowered CEIE members to share best practices and create tailored pathways that address local needs, mitigating the negative impact of the pandemic.

Looking ahead, the objectives of WFEO-CEIE, aimed at making engineering information globally accessible and fostering peace, socioeconomic security, and sustainable development, stand as guiding principles. Continued empowerment and collaboration will be essential to furthering these objectives and ensuring that engineering education remains a dynamic force in addressing the complex challenges of the future.

DECLARATION

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Latt T—Original draft preparation, Aung ZM—Reviewing and Editing.

Ethics approval
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Conflict of interest
The authors declare no competing interest.

Data availability statement
Not applicable.

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