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ENGINEERING MOBILITY: CONNECTING WORLDS

BEYOND MOVEMENT: ENGINEERING CONNECTIVITY ACROSS PHYSICAL AND DIGITAL WORLDS

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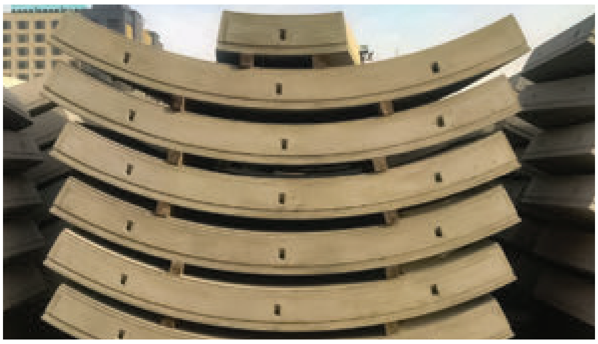

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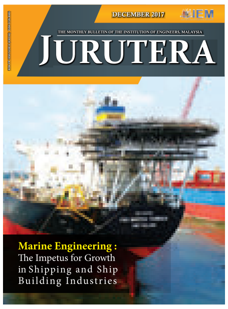
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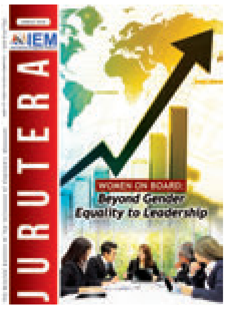
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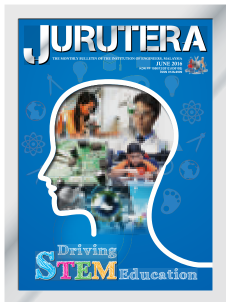
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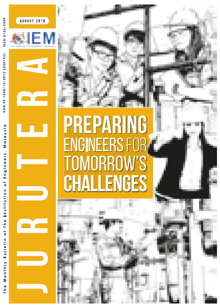
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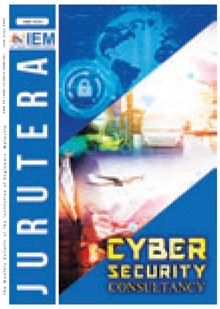
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In this month's issue of JURUTERA:

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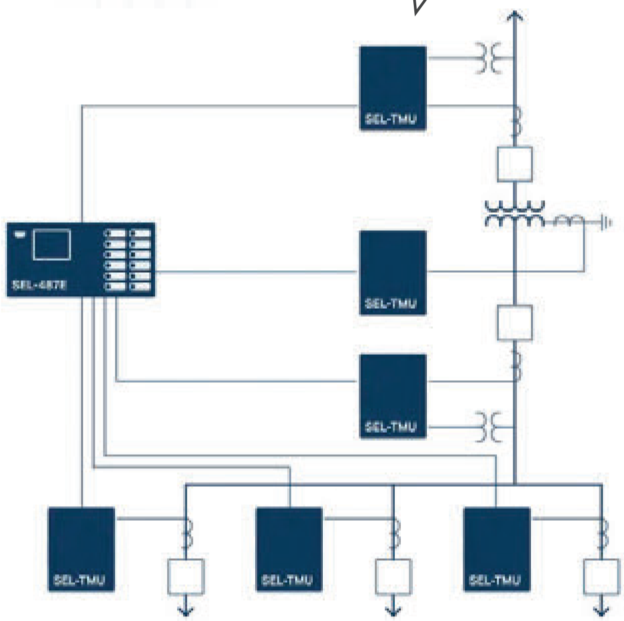

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COVER Note

by Ir.Ts. Dr Dhakshyani Ratnadurai
Chairman, Engineering Education Technical Division (E2TD) Session 2024/2025

Engineering Academicians with a Purpose

For the first issue of the *JURUTERA* Bulletin for 2025, IEM's Engineering Education Technical Division (E2TD) is showcasing Engineering Mobility: Connecting Worlds. E2TD has actively conducted webinars, physical talks, mock accreditation visits, technical visits, STEM related activities as well as the Prestigious Talk on Engineering a Sustainability Future related to integrating United Nations (UN) Sustainable Development Goals (SDGs) into engineering education.

E2TD committee members are striving towards creating more activities in relation to awareness of engineering fields which have become less popular in comparison to non-engineering fields.

Besides the importance of incorporating SDGs, it is also necessary for academicians and engineers to investigate current trends such as artificial intelligence (AI) as well as environment, social and governance (ESG) which are important and should be embedded in the engineering curriculum in order to benefit future engineering graduates so that they can be assets to the engineering fraternity. It is essential for us to be mobile and to keep up with the latest trends which lead to connecting the world. ■

EDITOR'S Note

by Ir. Alex Looi Tink Huey
Principal Bulletin Editor

Driving Forward: Engineering the Future of Mobility

Welcome to 2025, a year of fresh beginnings and boundless possibilities! This month, we embark on an exciting journey of Engineering Mobility: Connecting Worlds.

Mobility is more than moving people and goods; it's also about breaking barriers, forging connections and driving progress. Engineers are shaping the future with electric vehicles, smart transportation systems, innovative infrastructures and more. We will play a pivotal role in solving urban congestion, reducing carbon footprints and improving connectivity across ASEAN and beyond.

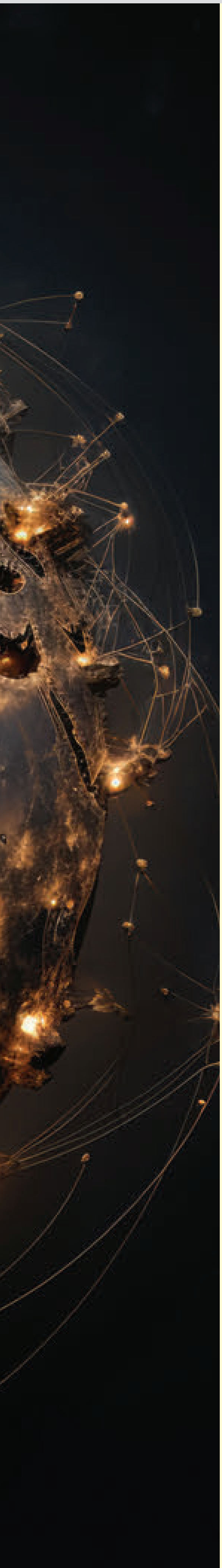
Let us dive into the challenges and opportunities of engineering mobility, from trailblazing technologies to policies that fuel sustainable growth and embrace the new year with optimism and ingenuity. ■

ENGINEERING MOBILITY:

Redefining Connections Across the Globe

Interviewee:
Ir. Megat Johari Megat Mohd Noor
Dublin Accord Executive Committee Chair

Chair of the Dublin Accord Executive Committee Ir. Megat Johari Megat Mohd Noor enlightens JURUTERA on the accreditation system of the Dublin Accord and what engineering students today need to master, apart from academic competency, in order to be industry-ready and to function on a global level.



Graduate Preparedness for the Workforce

As the Dublin Accord Executive Committee Chair, how well do you think fresh engineering graduates from Malaysia are prepared to meet the practical challenges of the global workforce? Are there specific skills or attributes that you feel are often lacking?

Communication skills are important if one is expected to function in a global scenario. The knowledge component (termed as knowledge profile in Dublin Accord) in a curriculum is deemed to have been fulfilled first. Dublin Accord is relevant at the Diploma level. Thus, a practice-oriented or work-based approach is highly desirable to provide real-life learning and to allow a smooth transition from education to the workplace.

However, some Diploma programmes are purely designed towards achieving academic competencies for articulation into a bachelor's degree. They are not terminal to produce industry-ready at Level 4. Programmes that incorporate the Dublin Accord 11 attributes and 9 knowledge profiles, scoped from a well-thought-out Programme Educational Objectives (where graduates will be employed), will easily produce relevant graduates as demanded by the industry stakeholders. As such, relevant industry stakeholders must be consulted in designing an industry-ready curriculum. Academic staff (with substantial industrial experience) must not forget that they are the "gate keeper" so as not to dilute the curriculum.

Importance of Soft Skills in Engineering

While technical proficiency is critical, how important are soft skills such as communication, teamwork and leadership? How does the Board of Engineers Malaysia (BEM) ensure that these are adequately integrated into the accreditation framework?

Gone are the days when engineers are regarded as backroom boys and girls. Engineering curricula are now more broad-based but without compromising on technical contents. Industry today expects graduates to continue to have strong fundamentals and to also be able to articulate themselves with relevant communities. Engineers are expected to be able to communicate effectively on complex engineering activities. Sustainability and environment, the intricate components in complex engineering problems, have to be suitability addressed.

Some aspects of social science provide the necessary knowledge to integrate these intricate components. Exposure to teamwork and leadership provides the smooth progression into the work life and these skills can be embedded within a number of project-based or competency-based courses. Accreditation by BEM will focus on the attributes or outcomes of the programmes, with emphasis on active learning approaches. Thus there are 11 programme outcomes, of which 6 focus on the non-technical outcomes and include communication, teamwork and leadership.

Global Recognition & Mobility

With the Dublin Accord focusing on global recognition of engineering qualifications, how does Malaysia's engineering accreditation system help ensure that our graduates are competitive and able to work internationally?

The Dublin Accord specifies the 11 generic attributes and 9 knowledge profiles for engineering technician education programmes. Programmes accredited under the Dublin Accord signatories are considered substantially equivalent. The accreditation system of the Dublin Accord signatory is also periodically reviewed by the Dublin Accord reviewers to ensure the robustness and consistency of the accreditation system.

BEM's Engineering Technology Accreditation Council (ETAC) has been a signatory of the Dublin Accord since 2018. Graduates are equally competitive in their ability to work globally, especially in signatory countries, since those qualifications are substantially equivalent. However, respective countries may have further requirements unrelated to academic qualifications, such as work permits and insurance, etc. These graduates will not be reassessed on their knowledge for work in these countries.

Adaptability to Industry 4.0

In the context of Industry 4.0 and the rapid technological advancements we are now witnessing, how should graduate attributes evolve to ensure that fresh graduates remain adaptable and future-ready?

Future-ready graduates are expected to solve complex engineering problems or problems the world has yet to see. Adaptability and relevancy in this technological age can only be sustained by having strong fundamentals. No programme, especially at the Washington Accord level, should compromise on the engineering sciences and core engineering areas.

In this era of Industry 4.0, all programmes must embrace it, whether it's at the Washington, Sydney or Dublin Accord level. Artificial Intelligence, the Internet of Things, Big Data, etc., are not only here to stay but are also evolving further with man-machine interfaces in providing engineering solutions.

Ethics & Professionalism in Engineering

Ethics and professionalism are key components of a graduate's development. How does the accreditation process ensure that new engineers are not only technically capable but also deeply committed to ethical practices in their professional life?

Delivering an engineering curriculum requires careful "choreographing" when dealing with affective components such as ethics and professionalism. This is best inculcated through leading by example and creating a scenario that challenges the students to function professionally and ethically. Teachers are the role model.

Continually raising the issues of ethics and professionalism that are embedded throughout the curriculum, even though some of these may not be assessed, will result in a behaviour change. Thus, assessment through observation, especially during the implementation of project-based courses, continual engagement with students and giving appropriate feedback are the pathways to success.

Exposing students to situational conflicting scenarios and bringing them to opine throughout the length of study instead of packing everything in a specific course will bring about change more effectively. In accreditation, the attributes or programme outcomes related to ethics and engineering practice should be demonstrated by the programme being accredited.

Bridging the Gap Between Academia & Industry Needs

There's often a perceived gap between what graduates learn in university and the expectations of Industry. How does the accreditation process address this gap and how can we ensure that engineering graduates are well-prepared to meet real-world demands?

Perceived gaps by Industry are often the result of the unawareness of differences in engineering and engineering technology education. Engineering education allows graduates to solve complex problems, whereas engineering technology education is aimed at solving broadly defined problems commonly in practice. Engineering education focuses on providing strong fundamentals and core specialised areas so that graduates can solve problems not even perceived as yet. Engineers are predominantly in the domain of design and research.

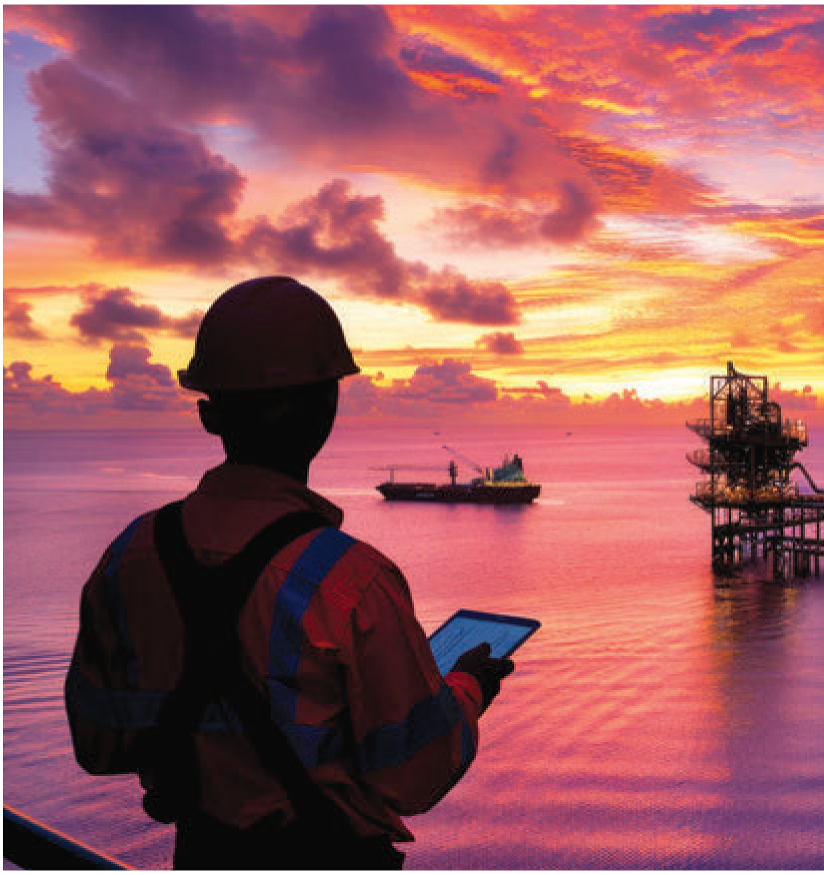
However, engineering technology education prepares graduates predominantly for operation, maintenance, manufacturing or construction. Engineering technology education is practice-oriented education which involves wide exposure to the practice area, which many current industries are interested in. Expecting engineering curricula to provide the best of both worlds will require more than the typical 4-year education.

Accreditation, however, requires institutions of higher learning to involve relevant stakeholders in the design and implementation of the curricula to meet Industry needs. Having said that, as an educational institution, the gatekeeper role must not be abandoned, as programme educational objectives are to meet several domains of graduate employment.

Continuous Learning & Professional Development

The engineering field demands lifelong learning. How does BEM, through accreditation, promote a mindset of continuous learning among fresh graduates to ensure they remain innovative and competitive throughout their careers?

Lifelong learning is a skill that can be inculcated in graduates through well-designed and implemented curricula. Most educational institutions see it purely from the assessment process through assignments. The whole curriculum can be embedded with lifelong learning requirements and, if they are drilled through the years, will become second nature.



Conducting a literature review is the basis for lifelong learning as, instead of "spoon-feeding" the students, the curricula should require them to also take charge of getting relevant knowledge. Accreditation thus demands the curricula to address the lifelong learning outcome. Implementing contextual learning which requires innovative solution, will provide a competitive edge for graduates in their careers.

Sustainability & Social Responsibility

As engineering increasingly intersects with sustainability and social responsibility, how can we embed these values more effectively in graduate attributes? What role does the accreditation process play in promoting these critical aspects in future engineers?

Evaluators in accreditation trained to ascertain programmes are indeed allowing students to solve complex problems. It is not just technical prowess that we need to attain but also the breadth of the curriculum, comprising sustainability, community, law, safety and health – components needed to solve complex problems. This is also true for engineering technology education, including at the diploma level, which will mostly address broadly defined or well-defined problems.

A programme is expected to address the context of Sustainable Development Goals. To just depend on a curriculum alone is not as effective as getting the students to obtain a "university experience", which means there is a need to provide a conducive environment for students to be part of the practice.

Apart from the social sciences component in a curriculum, social or community-oriented activities provide the necessary support to produce graduates with a sense of social responsibility.

Role of Internships & Practical Training

Practical training and internships are key to developing industry-ready engineers. Does the accreditation process in Malaysia emphasise these aspects and what suggestions do you have to ensure graduates gain sufficient hands-on experience before entering the workforce?

Industry wants work-ready engineers and universities have only 4 years to do so. As mentioned earlier, the engineering curricula produce engineers mainly for design and research, though they may also have the knowledge in operation, maintenance, construction or manufacturing. A longer duration of study is needed to produce engineers who can incorporate the practice-oriented components through practical training and internships. These two are used interchangeably, although internship is for those who have graduated. Industries need engineering technologists rather than engineers, as the former are mostly related to the operation, maintenance, construction or manufacturing sectors.

The role of producing industry-ready graduates is the responsibility of institutions which offer engineering technology programmes, though technically, industries are responsible for developing professional competencies through training and experiential learning.

Further compromise on students' knowledge components through extended training during their studies will result in graduates not having an adequate grounding in the fundamental knowledge, which is necessary to produce graduates who remain relevant despite the changing technological scenarios.

Global Standards vs. Local Context

While global standards are important for accreditation, how do we balance these against the local context and needs of the local engineering industry? How can we ensure that our graduates are both globally competitive and equipped to address local engineering challenges?

The International Engineering Alliance's benchmark which Malaysian engineering accrediting bodies (Engineering Accreditation Council and Engineering Technology Accreditation Council) have adapted are universal in nature and it allows local needs or requirements to be addressed. In fact, even foreign educational institutions operating in Malaysia are required to include the Malaysian context in their curricula.

So, graduates from Malaysian universities are expected to be able to address local needs as well as global requirements. This is why the curriculum must be clear on its objectives, the programme educational objectives as stipulated in the accreditation standard and call for graduates to have the abilities which ensure they are able to work in the relevant industries, be it locally or at international level.

Again, the inclusion of fundamentals in the curriculum will allow graduates to serve the local or international environment equally well. The values in the curriculum will become the impetus for graduates to ensure they have the necessary preparation to address all needs, local or international. ■

Ir. Megat Johari Megat Mohd Noor

The Chair of the Dublin Accord Executive Committee plays a significant role in Malaysia's engineering community. The former President of the Malaysian Society for Engineering & Technology (MySET) is a Board Member of the Board of Engineers Malaysia. He played a pivotal role in securing Malaysia's full signatory status in the Washington, Sydney and Dublin Accords. The founding professor and dean of the Malaysia Japan International Institute of Technology at Universiti Teknologi Malaysia as well as Director of the Quality & Risk Management Centre at its Kuala Lumpur campus, he helped develop the higher education rating systems for the Ministry of Education, such as MyRA and MyQUEST.

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Engineering Connectivity Across Physical and Digital Worlds

Prepared by:

Dr Praveena Nair Sivasankaran

TEDx Speaker, HRDC-accredited trainer and Deputy Director at Impact Lab Clean Technology. She inspires professionals to embrace resilience and purpose, driving impactful solutions for a sustainable future.

Figure 1: TWIZY is a two-seater, compact EV with zero emissions (Marsh. D(n.d))

In today's world, mobility goes beyond mere transportation. It has become a multi-dimensional, engineering-driven field that connects people, places, ideas and industries in ways once thought impossible. From self-driving cars and high-speed rail networks to remote digital connections, innovations in engineering mobility are not only transforming how we travel but are also bridging societal gaps and catalysing global unity.

In the past, mobility refers to the ability to move from one place to another. However, recent advancements have expanded this definition to include digital and social connectivity. Modern engineering is reshaping this landscape, aiming to not just transport individuals but to also create a seamless, interconnected world. The COVID-19 pandemic, for instance, demonstrated that work, education and commerce could continue virtually, emphasising that mobility now included digital connections (Smith, 2021).

This new approach to mobility centres on three core aspects: Physical, digital and social. Physical mobility, which includes innovations in transportation, is being transformed by electric vehicles (EVs), autonomous systems and efficient public transit options. Digital mobility refers to the ability to connect and collaborate regardless of location, enabled by advancements in communication technology, cloud computing and virtual platforms. Finally, social mobility addresses the ability to connect diverse cultures, communities and markets, creating a more inclusive world.

Transportation engineering has made significant strides toward enhancing physical mobility through sustainable and efficient solutions. The rise of EVs, for instance, is a major step forward. Tesla's innovative battery technology and energy management systems have set a benchmark in EV production, making EVs more accessible and environmentally friendly (Anderson, 2020). Other companies, such as Toyota and General Motors, have followed suit, focusing on reducing carbon emissions while maximising efficiency.

High-speed rail networks are another key innovation reshaping physical mobility. Japan's Shinkansen (bullet train) and Europe's extensive rail system exemplify how engineering can shorten travel times and reduce reliance on motor vehicles (Brown, 2019). Additionally, advancements in infrastructure materials, such as self-healing concrete, ensure these systems are built to last, reducing maintenance costs and environmental impact.

Figure 2: Futuristic high-speed bullet train illustration (OpenAI, 2024)

Figure 3: Interacting through virtual reality interface illustration in the future (OpenAI, 2024)

Autonomous vehicles (AVs) also stand at the forefront of physical mobility innovation. According to McKinsey & Company, autonomous driving technology can reduce traffic congestion by up to 30% and save billions in accident-related costs (Johnson *et al.,* 2021). Engineers are now working on algorithms to improve the safety and efficiency of AVs, addressing critical challenges such as object recognition, navigation in complex environments and real-time data processing.

Digital mobility is the ability to connect with others regardless of physical location, made possible through cloud computing, 5G technology and advanced communication platforms. As remote work becomes more prevalent, digital mobility enables people to contribute to the global economy from virtually anywhere. Platforms like Zoom and Microsoft Teams allow businesses to operate seamlessly across time zones, fostering global collaboration without the need for physical travel (Deloitte, 2022).

The rollout of 5G technology has further enhanced digital mobility by providing high-speed internet in previously inaccessible areas. According to Ericsson, 5G will cover over 65% of the global population by 2025, enabling digital access in rural and underserved regions (Ericsson Mobility Report, 2023). This connectivity not only benefits remote workers but also expands access to online education, healthcare and other essential services.

Another transformative innovation is cloud computing. By allowing data and software to be stored and accessed online, cloud platforms support a flexible, location-independent workforce. Engineers at Amazon Web Services (AWS) and Google Cloud are continuously improving cloud infrastructure, ensuring that data remains accessible, secure and scalable to meet the demands of a growing global workforce (AWS, 2022).

Engineering mobility also facilitates social mobility, promoting inclusivity and cultural exchange across borders. Social mobility has, historically, been limited by geographical, financial and educational barriers. However, engineering innovations are now breaking down these barriers, creating opportunities for people from all backgrounds to participate in the global economy.

For instance, digital platforms like LinkedIn and Upwork allow professionals from developing nations to find work opportunities globally, thereby enhancing their economic mobility (Kaplan & Haenlein, 2021). Moreover, virtual reality (VR) and augmented reality (AR) technologies enable immersive cultural exchanges, allowing individuals to experience different places and cultures without leaving their homes. According to a study by the World Economic Forum, VR-based cultural exchanges have significantly increased empathy and understanding among users from different cultural backgrounds (WEF, 2022).

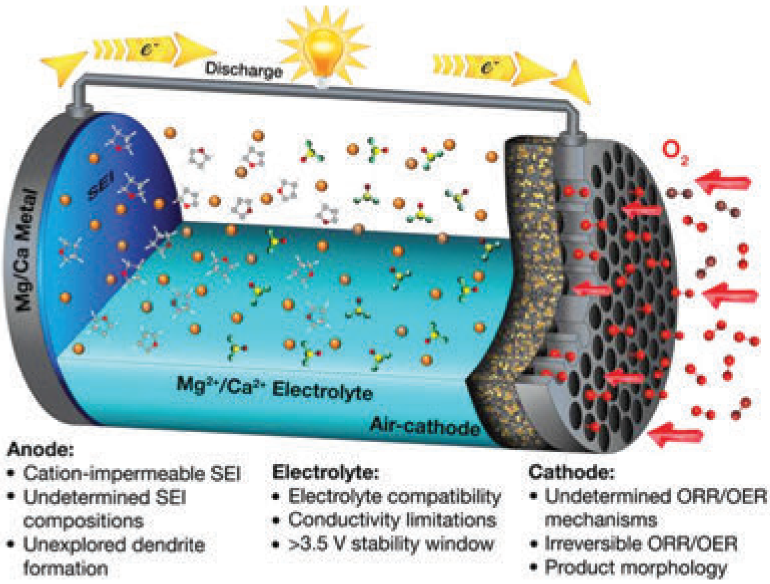

Figure 4: Structure and challenges of divalent nonaqueous metal-air batteries (Lu, Neale, Hu, & Hardwick, 2021)

Infrastructure engineering also plays a role in promoting social mobility. The construction of accessible public transportation systems, such as bike-sharing programmes and affordable bus networks, allows people of all income levels to move freely within urban areas. Cities like Amsterdam and Copenhagen have pioneered such inclusive mobility solutions, ensuring that everyone has access to safe, affordable and environmentally-friendly transportation options (Pucher & Buehler, 2019).

While engineering mobility offers numerous benefits, there are also significant challenges. Cybersecurity threats, for example, pose risks to digital mobility. As more data is stored and shared online, protecting personal and corporate information from cyberattacks is crucial. Engineers and cybersecurity experts are working together to develop robust encryption and authentication methods to safeguard digital connections (Gartner, 2022).

Environmental sustainability is another pressing issue. Although EVs and public transportation reduce emissions, the production of lithium-ion batteries has raised concerns about resource depletion and waste management. Researchers are exploring alternative materials, such as solid-state batteries and bio-based materials, to address these environmental challenges (Brown *et al.*, 2023).

Looking ahead, the integration of artificial intelligence (AI) in mobility solutions holds immense potential. AI-driven traffic management systems, for instance, can minimise congestion by adjusting traffic signals based on real-time data. Additionally, AI-powered translation tools may further break down language barriers, fostering even greater global connectivity (McKinsey Global Institute, 2024).

Engineering mobility is reshaping our world, fostering global connections and creating opportunities for people from all backgrounds. By enhancing physical, digital, and social mobility, engineering innovations are breaking down boundaries, promoting inclusivity and bridging cultural divides. As engineers continue to develop sustainable, secure and efficient mobility solutions, we move closer to a world where distance and location are no longer barriers to opportunity, understanding or unity.

In the years to come, engineering mobility will remain a powerful catalyst for progress, bringing people and ideas together in ways that transcend borders and redefine what it means to be connected. ■

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Engineering Mobility: Bridging Borders for a Connected Future

Prepared by:

Ir. Ts. Dr Nagentrau Muniandy

Senior Lecturer at School of Engineering, Faculty of Innovation & Technology, Taylor's University Malaysia.

In today's world, the boundaries between nations, industries and academia are rapidly diminishing. Engineers, once confined by geographical and disciplinary boundaries, can now collaborate with their peers in other continents to solve complex challenges.

The concept of engineering mobility is more than just the physical movement of engineers across borders; it is also about fostering a robust system of collaboration, networking and knowledge exchange to accelerate innovation and development in engineering.

This article explores the role of engineers and engineering education in enabling global connectivity, highlighting how mobility, whether intellectual, professional or physical, plays a critical role in transforming the future of engineering services and technology (Figure 1).

Engineers are at the forefront of solving the world's most pressing challenges, from climate change and sustainable energy to advancing healthcare and improving infrastructure. However, the complexity of these issues transcends borders, requiring a diverse range of expertise and collaborative efforts across geographical and cultural divides.

The traditional view of engineering as a localised profession is rapidly changing and engineers today must embrace a more global mindset. The evolution of engineering in the 21st century demands collaboration between disciplines. Whether it is the convergence of civil, mechanical and environmental engineering to designing sustainable cities, or the integration of software engineering and biotechnology to advance healthcare, engineers are increasingly working across traditional boundaries. This collaboration often takes place across countries, facilitated by communication technologies and digital platforms that connect engineers globally. The ability to share knowledge, insights and innovations has become essential for addressing global challenges.

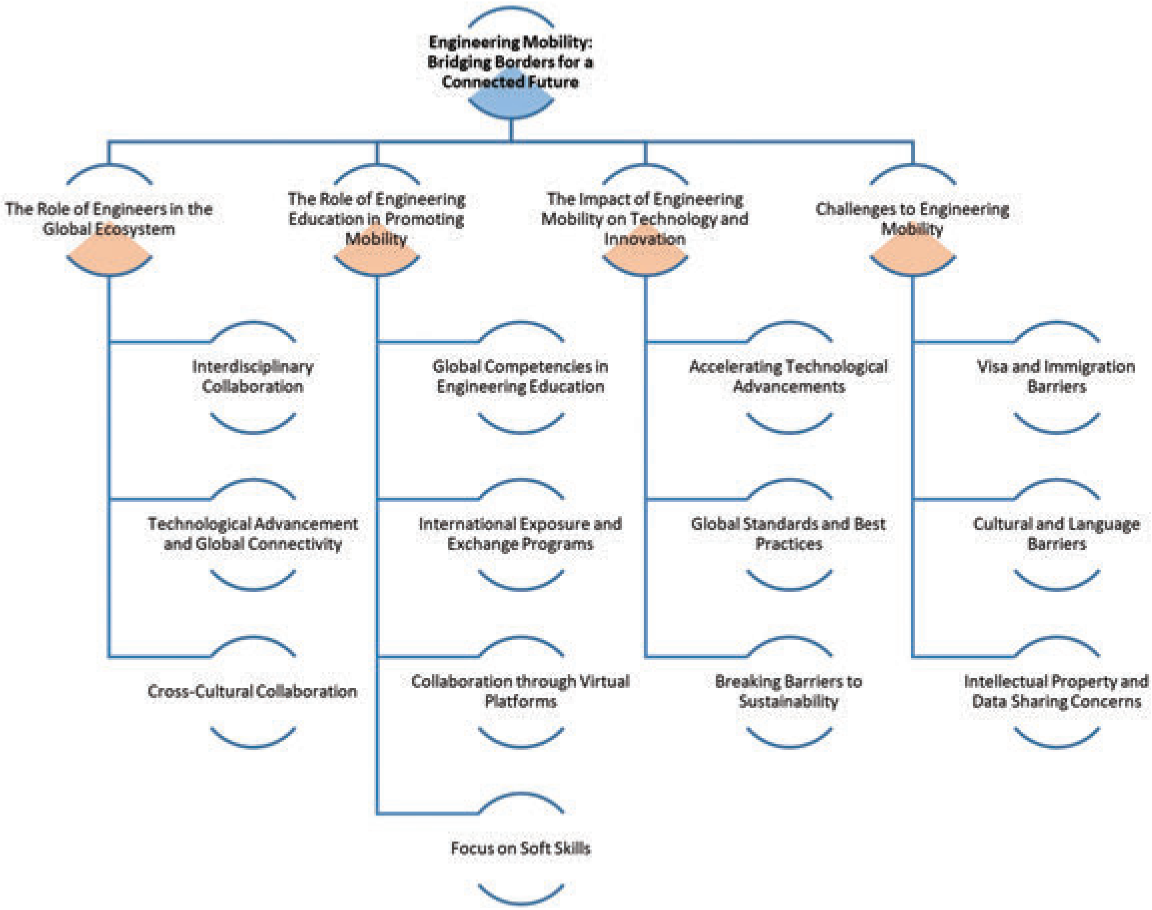

Figure 1: Engineering Mobility: Bridging Borders For A Connected Future

Advances in technology, such as cloud computing, artificial intelligence (AI) and the Internet of Things (IoT), have enhanced the ability of engineers to collaborate, regardless of location. Engineers can now access real-time data from anywhere in the world, participate in virtual teams and even work on projects remotely. These tools foster a connected environment where engineers can exchange ideas and solutions in ways that were previously unimaginable.

Engineering mobility is, therefore, not just about physical movement but the ability to leverage technological platforms that enable borderless collaboration. In a world where innovation is increasingly driven by cross-cultural understanding, engineers must develop skills to work with diverse teams. Different cultures approach problem-solving in different ways and this diversity can lead to more creative and effective solutions. Engineers must, therefore, embrace cultural intelligence alongside technical proficiency to navigate global projects successfully.

Cross-cultural collaboration fosters a spirit of inclusivity and diversity, which enriches the engineering process. To truly embrace the concept of engineering mobility, it is crucial that the next generation of engineers be equipped with the skills and mindset to engage in global collaboration. Engineering education plays a pivotal role in developing these competencies, preparing engineers for not just local markets but for a world that is increasingly interconnected. Engineering programmes are beginning to recognise the importance of global competencies.

Many institutions are incorporating courses and experiences that focus on global challenges, such as sustainable development, global health and international policy. By emphasising the importance of understanding the interconnectedness of global systems, engineering education fosters the mindset necessary for engineers to think beyond their immediate surroundings and to embrace a broader, more inclusive view of their work. Study abroad programmes, internships and international partnerships with engineering firms are invaluable in helping students gain exposure to different cultures, technologies and ways of thinking. These opportunities provide students with firsthand experiences in working with international teams, which is essential for fostering collaboration and understanding across borders. They also enhance technical knowledge by exposing students to diverse engineering practices and innovations which may not be prevalent in their home countries.

The rise of virtual learning environments and online platforms has made it easier for students to collaborate with their peers from around the world. Online engineering communities, open-source projects and global design competitions allow students to network, share ideas and solve problems together. These platforms help break down geographical barriers and enable students to work on real world problems with a global perspective.

Universities are increasingly recognising the need to incorporate these platforms into their curriculum to prepare students for the demands of a globally connected engineering world. While technical knowledge remains fundamental, engineering education is also placing greater emphasis on soft skills such as communication, teamwork and leadership. These skills are crucial for engineers working in global teams, where clear communication, collaboration and cultural sensitivity are key to success. Engineers must be adept at conveying complex technical information to a wide range of audiences, often in different languages or cultural contexts.

Engineering mobility facilitates the rapid exchange of ideas, allowing innovation to occur at an accelerated pace. For example, the development of renewable energy technologies has been significantly influenced by engineers from around the world who share their knowledge and collaborate on research. Whether it's the global push for more efficient solar panels or the development of smart grid technologies, the exchange of ideas and technology across borders has been crucial in advancing these innovations.

The collaborative nature of modern engineering ensures that the best minds are working together to solve problems more effectively. One of the significant benefits of engineering mobility is the development of global standards and best practices. Engineers who work across borders often bring different perspectives and experiences, helping to establish universal guidelines which can be adopted globally. These standards ensure that technologies and services meet consistent quality and safety benchmarks, regardless of where they are developed or implemented. Global collaboration also leads to the creation of open-source technologies that can be shared and adapted worldwide.

Engineering mobility plays a critical role in advancing sustainability efforts worldwide. For example, engineers from various countries collaborate to create solutions for sustainable energy, water management and waste reduction. This collaboration ensures that sustainability efforts are not isolated to specific regions but are part of a collective global movement. Engineers can share the best practices and technologies which have been successful in one region and adapt them to meet the needs of another, ensuring that sustainability becomes a worldwide endeavour.

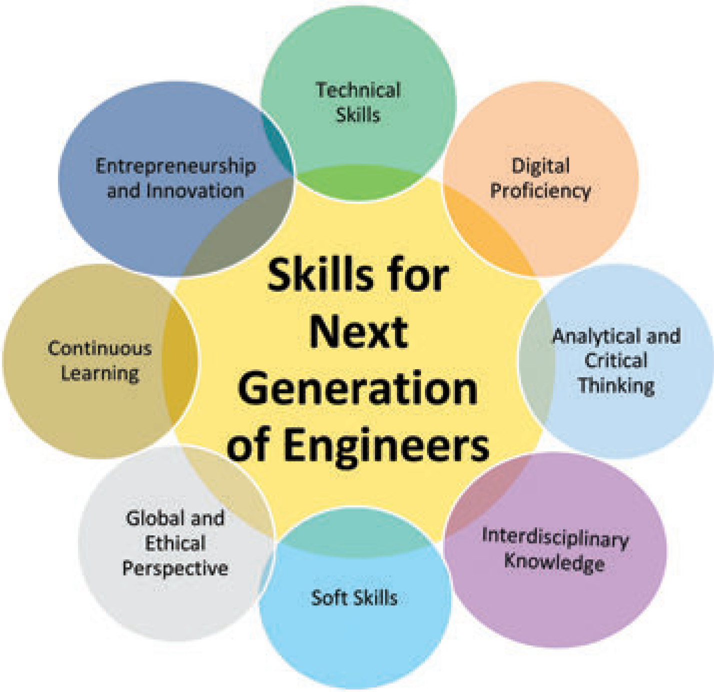

Figure 2: Skills for the next generation of engineers

While the benefits of engineering mobility are clear, there are also challenges that need to be addressed. Engineers often face bureaucratic hurdles when attempting to work in different countries. Visa and Immigration restrictions can limit opportunities for collaboration and mobility. Governments and international organisations must work together to streamline these processes, ensuring that engineers can move freely to contribute to projects across borders.

Working in global teams often involves overcoming cultural and language differences. Engineers must be prepared to communicate effectively across these differences, which may require additional language skills or cultural training. Cross-cultural competence is an essential part of modern engineering education but more can be done to ensure that engineers are equipped to navigate these challenges. Collaboration across borders may raise concerns about intellectual property rights and data security.

Engineers must work within frameworks that protect their innovations while ensuring that knowledge and technology is shared freely and securely. International agreements and partnerships will be key to balancing these concerns.

Engineering mobility is not just a trend; it is the future of the engineering profession. Engineers who embrace global collaboration and networking will be better equipped to tackle the world's most pressing problems. Engineering education, with its emphasis on global competencies, soft skills and international exposure, plays a crucial role in preparing the next generation of engineers for this interconnected world. Figure 2 shows skills that can empower future engineers. As barriers continue to fall, the role of engineers in bridging borders and advancing technology will become more critical, ensuring that engineering continues to drive progress and innovation on a global scale. ■

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NEWLY ELECTED OFFICE BEARERS OF IEM (PAHANG BRANCH) SESSION 2024 / 2025

We are pleased to inform you that the 12th Annual General Meeting of The Institution of Engineers, Malaysia, Pahang Branch was held at Sri Manja Boutique Hotel, Kuantan on Sunday, 8 December 2024. The new elected office bearers for the key positions in the IEM, Pahang Branch for session 2024/2025 are:

IEM Pahang Branch Executive Committee 2024 / 2025		
Chairperson	Ir. Harzah Masni Ramli	
Vice Chairman	Ir. Dr Azhani Zukri	Ir. Dr Hj. Salimi Md Saleh
Honorary Secretary	Ir. Ts. Aideelnorfahmee Mohamad	
Honorary Treasurer	Ir. Dr Chin Siew Choo	
Internal Auditor	Ir. Dr Asnul Hadi Ahmad	Ir. Aiman Ismail
Elected Council Member	Ir. Dr Marzuki Ab Rahman (Civil) Ir. Ts. Muhamad Syakir Zulkafli (Civil) Ir. Dr Muhamad Zahim Sujod (Electrical) Ir. Hazri Dahalan Md Razip (Electrical)	Ir. Ts. Mohd Azrul Nizam Mohd Zahir (Mechanical) Ir. Dr Rashidi Maarof (Mechanical) Ir. Ts. Khairul Najah Ishak (Women Engineer)
Appointed Council Member	Ir. Hj. Mansor Ibrahim Ir. Syed Mohd Syawal Syed Ahmad Ir. Ts. Mohd Ridhuan Ismail	Ir. Mohd Shahrul Effendy Ahmad Pn. Siti Hanis Syazana Mohamad

Technology Trends in Aerospace Manufacturing for the Malaysian Market

Prepared by:

Ts. Muhamad Farouk Abdul Rashid

Lecturer at Polytechnic Banting Selangor's Department of Aircraft Maintenance. He graduated with first-class honours in BSc Aircraft Maintenance Engineering – Turbine Aircraft from University of Glamorgan, United Kingdom.

The Malaysian aerospace industry was strategically planned by the Malaysian Investment Development Authority, which began the release of the National Aerospace Blueprint in 1997[5]. The Malaysian Aerospace Council was established in 2001 and the Malaysia Aerospace Industry Blueprint 2030 (MAIB 2030), which was launched in 2015, solidified the aerospace industry as an essential component[5].

MAIB 2030 focuses on the following areas: Aero Manufacturing, Aircraft Maintenance, Repair & Overhaul, System Integration, Engineering & Design Services and Education & Training[1]. In addition, by incorporating other sub-sector categories in the 2030 blueprint, Malaysia is expected to create more than 32,000 well-paying jobs as well as generate an annual revenue of RM55.2 billion by 2030, making it the leading aerospace industry country in South-East Asia and a crucial component of the international market[1]. Figure 1 illustrates an overview of MAIB 2030.

With the goals outlined in the MAIB 2030 for aero manufacturing, Malaysia's focus is on implementing cutting-edge aerospace manufacturing technologies such as, but not limited to, Additive Manufacturing (AM). With such advanced manufacturing techniques, the industry is beginning to report lower prices, shorter lead times and vast improvements in flexible design[3]; this will help the nation realise its ambition to become the premier aerospace hub in South-East Asia and be a major player in the global industry.

Additive Manufacturing in Aerospace

With AM technology, materials are created layer by layer, offering great flexibility and precision in the construction of complicated aircraft designs that were previously impossible to achieve by using traditional methods[7]. The AM technique is transforming aircraft design by optimising parts for weight and strength, allowing for totally new ideas. With AM, accurate components may develop with little material utilisation, in contrast to traditional subtractive manufacturing that entails cutting off materials and producing waste. Thus, this technology is being increasingly adopted by the aerospace industry for applications that range from lightweight structural components to turbine blades, greatly boosting efficiency and performance[7].

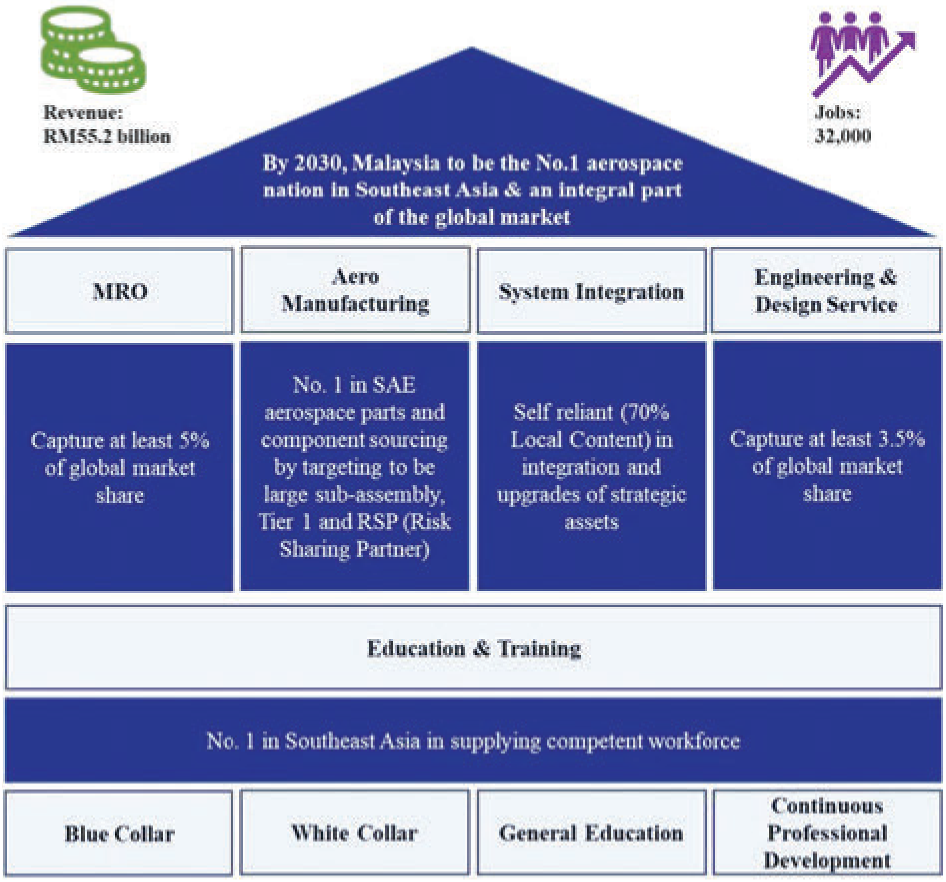

Figure 1: Overview of Malaysian Aerospace Industry Blueprint 2030[6]

Based on this information, AM is regarded as a potential solution for the future of aerospace industry since it reduces waste in the manufacturing process and improves fuel economy by producing lighter components, hence promoting environmental sustainability.

Figure 2: The evolution of traditional manufacturing to Additive Manufacturing[4]

Figure 2 illustrates the evolution of traditional manufacturing to AM and how the use of 3D printing in aircraft design has influenced the industry by enabling the development of complex, lightweight parts and components, resulting in significant long-term cost reductions. This development can greatly help Malaysia's aspiration to become a major player in the global industry and the premier aerospace hub in South-East Asia.

Challenges in Aerospace Additive Manufacturing

According to Chad Brinkle[2], the aerospace industry faces several issues with AM which will need a forward-thinking strategy. The main concern is the certification and accreditation of 3D-printed components to guarantee their dependability and safety of use; it is also crucial to set strict guidelines and protocols for approving these components.

To ensure 3D-printed components meet or surpass conventional manufacturing standards, industry and regulatory authorities must work together to develop and validate protocols for the whole manufacturing process, from design to post-processing. Quality control must also be improved alongside the use of new inspection techniques, such as non-destructive testing and digital twin technologies, to spot flaws early and to assure high-quality output[2]. Therefore, it seems that addressing these challenges is essential to ensure the seamless adoption and application of AM technologies in Malaysia and to mitigate any potential problem.

Conclusion

The goal of MAIB 2030 is to position Malaysia as the premier aerospace hub in South-East Asia, with a particular emphasis on becoming a major supplier of large subassemblies, Tier-1 and risk-sharing partners in the global market.

Therefore, incorporating cutting-edge technology such as AM will be essential to achieving this goal. AM technologies have several benefits, including cheaper expenses, less waste and the capacity to produce complex, lightweight parts that are in line with aerospace development goals.

To successfully implement AM technologies and ensure that Malaysia can satisfy international standards as well as maintain its position as a significant player in the aerospace sector, issues related to certification and quality control must be addressed. ■

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Academician Dato' Ir. Prof. Dr Chuah Hean Teik Engineering Education Prestige Lecture Series 2024

Prepared by:

Ir.Ts. Dr Dhakshyani Ratnadurai

The Prestige Lecture Series was organised by IEM's Engineering Education Technical Division (E2TD) on 23 November 2024 from 9.00 a.m. to 11.00 a.m. at Wisma IEM. Academician Ir. Prof. Dr Rajkumar Durairaj was the guest speaker. His lecture was titled Engineering a Sustainable Future: Integrating UN Educational Sustainable Development Goals in Engineering Education.

There were approximately 20 participants including IEM President Ir. Prof. Dr Jeffrey Chiang Choong Luin, E2TD chairman Ir. Ts. Dr Dhakshyani, committee members Ir. Dr Baljit, Ir. Sukhairul, Ir. Yong, Ir. Mathan and IEM participants.

Background on IEM Academician Dato' Ir. Prof. Dr Chuah Hean Teik Engineering Education Prestige Lecture Series

The *IEM Engineering Education Prestige Lecture Series* is a distinguished platform hosted by the Institution of Engineers Malaysia (IEM) and aimed at advancing the field of engineering education. The series brings together industry experts, academics, and policymakers to discuss emerging trends, best practices, and challenges in engineering education, with a focus on preparing students for the rapidly evolving demands of the engineering profession.

Dato' Ir. Prof. Dr Chuah Hean Teik, a highly respected academician and engineer, has been a keynote figure in this lecture series. Known for his leadership in engineering education, Prof. Dr Chuah brings a wealth of experience from both academia and industry. His work focuses on improving the quality and relevance of engineering education through initiatives that integrate practical skills, industry alignment, and cutting-edge research. This series, and particularly Dr Chuah's contributions, provide valuable insights into the future of engineering education, the role of technology, and the ways in which engineering can drive innovation and economic development in Malaysia.

In the inaugural lectures, Prof. Dr Chuah addresses pressing topics, including how educational institutions can adapt curricula to prepare students for new challenges in fields like digital transformation, sustainability, and advanced manufacturing. His contributions to the *Prestige Lecture Series* underscore the need for a dynamic, forward-looking approach to engineering education that aligns with global standards and industry demands. This series not only elevates discussions around engineering education but also serves as an inspiration for young engineers and educators aiming to make impactful contributions to society.

Prof. Jeffrey presenting a token of appreciation to Prof. Rajkumar. Looking on is Ir. Dr Dhakshyani

Key Points of the Lecture

Prof. Dr Rajkumar delved into the integration of UN Sustainable Development Goals (SDGs) within engineering education, exploring ways that these goals can shape sustainable and socially responsible engineering practices. The benefits of ESG integration are:

- Producing holistic graduates
- Raising ethical and sustainability awareness
- Preparing for global challenges
- Greater innovation and adaptability.

ESG can be applied to specific engineering subjects such as in integrated design projects and final-year projects to make it more relevant.

Challenges in Integrating SDGs

The lecture also addressed the challenges of ESG integration such as:

- Strain on existing curriculum
- Lack of resources for faculty training
- Lack of expertise
- Cost.

The key focus was on the ways ESG integration can help engineering programmes in meeting essential graduate attributes, including ethical responsibility, sustainability awareness and global citizenship, as well as core competencies such as problem-solving, teamwork and effective communication.

Group photo

Future Directions

Finally, the session covered the future direction of engineering education, emphasising the importance of a cohesive strategy that integrates industry collaboration, policy support and cross-disciplinary learning. This aim was to ensure that engineering graduates not only possess technical expertise but are also prepared to contribute meaningfully to the global SDGs.

At the end of the lecture, participants raised questions and issues in relation to the time limit and effectiveness of producing quality engineering graduates and the speaker provided clear explanations to all the questions.

Conclusion

Overall, the lecture offered a good perspective on the future direction of embedding SDGs in the academic and professional fields which can benefit the current and future generations of engineers. This lecture inspired participants to take the first step to align their curriculum with SDGs, thereby preparing Malaysian engineers to address global challenges. ■

List of Academician Dato' Ir. Prof. Dr Chuah Hean Teik Engineering Education Prestige Lecture Series

Date	Speaker	Title
18/2/2012	Academician Dato' Ir. Prof. Dr Chuah Hean Teik	Science, Engineering, Technology & Innovation Education For Economic Transformation
2/3/2013	Academician Professor Tan Sri Dr Ghauth Jasmon	High Impact Research – World Competitiveness, Value Creation, and High – End Education
10/5/2014	Dato' Ir. Prof. Dr Mashkuri Yaacob	Engineering Education: Where Are We Heading to?
1/8/2015	Tan Sri Dato' Ir. Muhammad Radzi Mansor	Training of Future Engineers: Success Story of TM Engineers From Training School to University Level
12/3/2016	Dato' Ir. Prof. Zaini bin Ujang	Eco- Strategy: Development of Business and Technical Tools for Environmental Sustainability
5/8/2017	Ir. Assoc. Prof. Abdul Aziz Omar	Ensuring Global Acceptance of Malaysian Engineers and Engineering Technologists
1/9/2018	Dato' Prof. Dr Noraini Idris	STEM Education: Engine for Growth
27/4/2019	Academician Tan Sri Ir. Dr Ahmad Tajuddin Ali	The Challenges Ahead and our Role as Engineers
14/10/2023	Dato' Ir. Prof. Dr Mohd Hamdi bin Abd Shukor	Future of Engineering Education: Global Perspective
23/11/2024	Ir. Prof. Dr Rajkumar Durairaj	Engineering a Sustainable Future: Integrating UN Educational Sustainable Development Goals in Engineering Education

Technical Visit to Gardenia Bakeries Bakers Maison

Prepared by:

Ir.Ts. Dr Dhakshyani Ratnadurai

IEM's Engineering Education Technical Division (E2TD) organised a technical visit to Gardenia Bakeries' Bakers Maison at 35, Persiaran Sabak Bernam, Shah Alam, on 26 November 2024. It was a great two-hour visit and the 35 participants gained plenty of knowledge as well as had an exciting time.

Our guide was Ms. Wan Hui Xin, the Public Relations Assistant of Gardenia. The visit began with a video presentation on Gardenia which has eight factories in Peninsular Malaysia, with the capacity to produce diverse products daily. These include a wide selection of breads, buns, rolls, cakes, waffles, wraps and other products such as spreads and yellow noodles. Gardenia produces 8,000 loaves of bread every hour.

As we walked to the factory for our tour, we could smell the lovely aroma of baking. We witnessed the incredible journey of making bread, from the massive machines in action, dough preparation, kneading, slicing, filling and packaging. The entire process was marvellous to watch.

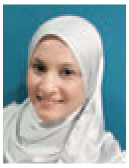
The factory is fully automated and strictly adheres to cleanliness standards, high efficiency and is committed to safety and sustainability. Gardenia has certificates in Hazard Analysis Critical Control Point (HACCP) by the Ministry of Health Malaysia and ISO 22000 certification in Food Safety Management System with compliance in Good Manufacturing Practices (GMP). All these show that Gardenia practises healthy food safety standards.

Ms. Wan then brought us to the Gardenia products shop where we were served waffles, coffee and tea. At the end of the tour, Gardenia also presented each participant with a bag containing various Gardenia products. Overall, the participants had an enjoyable experience and gained insightful knowledge on the making of Gardenia bread using modern manufacturing technology. ■

IEM participants posing for a group photo at Gardenia Bakeries' Bakers Maison

International Collaborative Visit to Tharn Technological College, Thailand

Prepared by:



Ir. Ts. Ainon Shakila Shamsuddin

The international visit to Tharn Technological College, Thailand, by the Politeknik Banting Selangor (PBS) delegation from November 10 to 12, 2024, was a follow-up visit as part of the established collaboration for the Student Mobility Programme in Aircraft Maintenance.

The 24-member delegation, led by PBS Director Ts. Ibrahim Burhan and Deputy Director En. Roswady Abdul Wahab, received a warm welcome from Dr Pakdee Tharnpanya and the senior management of the college. Also taking part in the visit was Ir. Ainon Shakila Shamsuddin, representing IEM E2TD, to explore potential collaborative opportunities between IEM and Tharn College.

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Tharn Technological College offers certificate and diploma programmes in various fields, including Automotive Technology, Electronics, Electrical Power, Automotive Service Advising, Business Computing, Marketing, Management, Hotel & Tourism, Aircraft Maintenance, Railway Technology and Electric Vehicles.

Mr. Aong, head of the Railway Technology Department, explaining the EV model and control boards used for training purposes

Group photo taken at Tharn Technological College

I MAC lab facilities and students STEM project display on notice board

The visit began at 9.00 a.m. (Bangkok time) with a warm reception from the students and management of Tharn College, followed by a group photo. The delegation was then guided to the boardroom, where they were welcomed by the College Director, Mr. Dachai Pacheen, and the Deputy Director of Communication, Mr. Charoen Insuk. Then there was a video presentation.

The visit included a tour of the college, an exploration of their technical programmes and facilities as well as deliberations on incorporating STEM programmes for students.

Following this, the delegation visited the training centre for new energy vehicle technology, showcasing the workshop for teaching Electric Vehicle (EV) mechanics. This included detailed demonstrations of disassembled EV body parts to show their inner structures. Additionally, the control circuit boards were presented, offering insights into the fundamental electronics and control systems that power EVs. This helped students develop practical skills in diagnosing and repairing electronic components essential to electric vehicle operation.

The visit fostered positive discussions which laid the groundwork for strategic cooperation. The collaboration is expected to enrich the academic and professional growth of students and to contribute to enhanced technical knowledge sharing between the institutions.

The visit concluded at 2.00 p.m. with a gift exchange between Ts. Ibrahim Burhan and Dr Pakdee Tharnpanya. ■

NOTICE ON NOMINATION PAPERS FOR COUNCIL ELECTION SESSION 2025/2026

A notice inviting nominations for the Election of Council Members for Session 2025/2026 was posted on the IEM Notice Board and IEM website on 1 November 2024 for the information of all Corporate Members. Following the close of nominations on 7 December 2024, the election exercise will proceed. All Corporate Members residing overseas are requested to take note of the requirements of the Bylaw, Section 5.17, as shown below.

> *The voting paper (in hardcopy or electronic form) shall, not less than twenty-eight (28) clear days before the date of the Annual General Meeting, be sent by post or in electronic mail or message to all Corporate Members. The voting paper (in hardcopy or electronic form) shall be returned or submitted online and in turn notified to the Honorary Secretary in a sealed envelope or electronically encrypted format so as to reach him by a specified date not less than seven (7) days before the Annual General Meeting.*

Electronic Ballot Papers will be sent to all Corporate Members by **3 March 2025**.

Thank you.
Election Officer, IEM

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IEM Kuala Lumpur Engineering Science Fair STEM Challenge 2024 (IEM KLESF 2024)

Prepared by:

Ir. Ts. Zainon Sharmila Shamsuddin

The Kuala Lumpur Engineering Science Fair (KLESF), held on November 8-10, 2024, was a national-level initiative aimed at sparking interest in science, technology, engineering and mathematics (STEM) among primary and secondary school students.

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The event emphasised fostering innovation, creativity and critical thinking through collaborative teamwork and hands-on learning. It provided a platform for students to apply STEM knowledge to real-world challenges while engaging with professionals, educators and peers. This enriching experience would inspire and nurture the next generation of engineers and scientists.

The Engineering Education Technical Division (E2TD), in collaboration with The Institution of Engineers Malaysia (IEM), hosted a dedicated booth on November 9, 2024, which featured engaging STEM activities for participants and was overseen by Ir. Ainon Shakila and Ir. Zainon Sharmila, with the support of two student helpers.

Representatives from IEM- E2TD

Group photo with students

They organised various hands-on sessions aimed at fostering curiosity and enhancing the students' understanding of STEM concepts. Through interactive demonstrations and collaborative projects, the booth attracted numerous students and educators, providing them with valuable insights into practical applications of engineering principles.

Activities during the fair

E2TD organised a few activities for the students. In one of the key activities, participants constructed robotic hands using straws, paper and string, which allowed them to explore the mechanics of movement and robotics in a fun and accessible way.

Participants also took part in building bridges using popsicle sticks, an activity that introduced them to the basic principles of structural engineering and design. Using simple tools and techniques, the students assembled the bridges, focusing on ways to enhance their strength and stability. The completed designs were then tested under load to evaluate their durability and structural performance.

The event attracted participation from a diverse group of students, including those from primary and secondary schools, A-level programmes and international students from Indonesia. The activities were designed to be interactive and educational, encouraging active engagement and problem-solving skills. Students who successfully completed the activities were rewarded with prizes, adding an element of excitement and motivation to their learning experience. ■

Upcoming Activities

Webinar Talk on Sustainable Solution for Building Foundation		
Date	:	15 January 2025 (Wednesday)
Time	:	5.00 p.m. - 7.00 p.m.
Venue	:	Digital Platform
Approved CPD	:	2
Speaker	:	Dr. Huong Tran Phuong Nam

Physical Half-Day Seminar on “Battery Energy Storage System”		
Date	:	16 January 2025 (Thursday)
Time	:	1.30 p.m. - 6.30 p.m.
Venue	:	Wisma IEM
Approved CPD	:	4
Speakers	:	Mr. Kolin Low
	:	Mr. Ho Victor
	:	Ir. Alan Chan Teck Wai
	:	Dr. Chiam Sing Yang

Virtual One-Day Workshop on "Introduction to Solidworks 2025"		
Date	:	18 January 2025 (Saturday)
Time	:	9.00 a.m. - 5.30 p.m.
Venue	:	Digital Platform
Approved CPD	:	6
Speaker	:	Mr. Jitendra Kumar Nayak

Technical Visit to CB 200 BRIDGE, 91 RAJD Support Regiment		
Date	:	21 January 2025 (Tuesday)
Time	:	8.15 a.m. - 1.30 p.m.
Venue	:	91 Rej Bantuan RAJD, Kem Batu Kentonmen, Jalan Ipoh, 51200, Kuala Lumpur
Approved CPD	:	3

Hybrid Half-Day Seminar on “Innovation in Instrumentation and Monitoring for Tunnelling Works” (Physical Platform)		
Date	:	22 January 2025 (Wednesday)
Time	:	8.30 a.m. - 1.30 p.m.
Venue	:	Digital Platform and Wisma IEM
Approved CPD	:	4
Speakers	:	Dr. Henry Tan
	:	Dr. Tee Bun Pin

Technical Talk on From Vision to Reality: Achievements of the Malaysia Road Safety Plan 2014 – 2024 and Insights into the Road Safety Plan 2022 – 2030		
Date	:	25 January 2025 (Saturday)
Time	:	9.00 a.m. - 12.00 p.m.
Venue	:	Wisma IEM
Approved CPD	:	2
Speaker	:	Ir. Ts. Sharifah Allyana


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Safety Engineering: Challenges, Innovations and the Future

Prepared by:

Ir. Assoc. Prof. Dr Zaki Yamani Zakaria

Ir. Assoc. Prof. Dr Mazura Jusoh

Safety engineering is an essential discipline that underpins the ability of industries to operate efficiently, responsibly and sustainably while prioritising the well-being of their workforce and the communities they serve.

In an era of rapid technological advancement and shifting industrial landscapes, the field is undergoing a significant transformation. From addressing the complexities of automation and artificial intelligence (AI) to managing the risks of interconnected systems, safety engineering faces both pressing challenges and unprecedented opportunities.

Innovations such as predictive analytics, real-time monitoring and adaptive safety protocols are reshaping how industries approach risk management and resilience. Moreover, as emerging technologies like renewable energy, autonomous vehicles and smart factories become more prevalent, safety engineering is evolving into a proactive force that not only prevents accidents but also drives innovation and sustainability. This article explores the key challenges, groundbreaking innovations and future directions shaping the dynamic field of safety engineering for selected areas.

Challenges in Safety Engineering

One of the critical challenges in safety engineering is managing risks in increasingly complex industrial systems. Advanced technologies, interconnected supply chains and rapid automation have introduced new safety concerns, including system vulnerabilities and unanticipated risks. Industries must address these issues while ensuring compliance with ever-changing regulatory standards.

Human error also remains a significant factor in workplace accidents. Safety strategies now focus on minimising errors through intuitive design and technology integration, such as behavioural monitoring systems. On top of that, mental health concerns are increasingly recognised as integral to overall safety. Chronic stress, burnout and fatigue are examples of mental health which can impair decision-making, reduce situational awareness and increase the likelihood of accidents, making mental health a critical factor in ensuring a safe working environment. As industries grow more complex and demanding, addressing these issues has become a key challenge for safety engineering (Hammer *et al.*, 2024). Neglecting mental health can lead to increased stress, reduced productivity and higher accident rates, ultimately undermining the overall effectiveness of workplace safety systems.

Industrial Smart Safety Helmet (Lee el al., 2022)

Another key challenge in safety engineering is fostering a safety-first culture. Despite the safety-first concept being introduced over three decades ago, embedding this culture consistently across industries remains a significant challenge. The challenge lies in overcoming complacency, resistance to change and ensuring consistent adherence to safety protocols across diverse teams and complex operations. While there are undoubtedly many more challenges that can be explored and discussed, our focus will remain on the one highlighted above.

Innovations in Safety Engineering

Emerging technologies are reshaping the field of safety engineering. Wearable devices equipped with environmental and biometric sensors provide real-time feedback, enabling workers and supervisors to pre-emptively address potential hazards. For example, smart helmets can detect changes in air quality, alerting wearers to harmful conditions before exposure occurs (Lee *et al.,* 2022).

AI and machine learning have transformed safety management. Predictive analytics powered by AI can forecast equipment failures and operational risks, enabling proactive measures to prevent accidents. Similarly, robotics and drones are being utilised to perform high-risk tasks, such as inspections and hazardous material handling, reducing human exposure to danger (Kas and Johnson, 2019).

Virtual reality (VR) and augmented reality (AR) are revolutionising safety training. These immersive technologies simulate hazardous scenarios, allowing workers to practise and refine their responses without real-world risks. This approach has proven particularly effective in industries like construction and energy, where high-risk situations are common (Alzarrad *et al.,* 2024).

Ir. Assoc. Prof. Dr Zaki in Virtual Reality safety training demo in a Safer World Conference 2022 in London

For mental health, innovations such as wearable stress monitors, AI-driven mental health analytics and VR training are enabling safety engineering to promote early detection and building resilience in workers. These innovations focus on creating supportive environments through AI-driven monitoring tools, communication platforms and training programmes that foster trust, inclusion and mental well-being.

Innovations for a safety-first culture in safety engineering include implementing AI-powered behaviour tracking, gamified safety training and real-time feedback systems to reinforce proactive safety behaviours and accountability. These technologies not only enhance engagement and compliance but also provide data-driven insights to identify risks and tailor interventions, creating a more dynamic and responsive safety culture.

Future of Safety Engineering

The future of safety engineering in complex industrial systems lies in integrating advanced technologies such as artificial intelligence, digital twins and predictive analytics to enhance real-time risk assessment and system resilience. These technologies have already been implemented and will continue to evolve and mature over time. These innovations will enable industries to anticipate failures, optimise safety protocols and adapt to evolving operational demands with unprecedented precision and efficiency.

The future of safety engineering for mental health lies in integrating advanced neurotechnology, personalised interventions and workplace cultures that prioritise psychological well-being alongside physical safety. It will soon become evident that the focus will shift towards designing inclusive systems and leveraging advanced technologies to foster trust, collaboration and a culture where employees feel safe to voice concerns and take risks.

Cultivating a safety-first culture within organisations is another on-going essential aspect. It must be improved upon and continuously developed. Leadership must prioritise training, compliance and continuous improvement, embedding safety as a core organisational value. Such cultural shifts ensure that safety remains at the forefront of decision-making, driving consistent improvements across industries (Moore, 2024).

The future of safety engineering will focus on cultivating a proactive safety culture through advanced technologies, data-driven insights and inclusive practices that prioritise both physical and psychological well-being.

Conclusion

Safety engineering is evolving rapidly in response to the growing complexity of industrial systems and emerging technologies. The challenges faced, from managing risks in interconnected systems to addressing the mental health concerns which impact safety, require innovative solutions such as AI-powered predictive analytics, wearable devices and immersive training platforms. As industries continue to advance, the future of safety engineering lies in the integration of these technologies to not only enhance physical safety but also to foster a culture that values psychological well-being.

By focusing on inclusivity, data-driven insights and proactive safety practices, safety engineering will continue to shape a safer, more resilient and sustainable industrial landscape. The key to success will be embedding safety as a core organisational value, ensuring that both physical and mental health are prioritised in every facet of operations. ■

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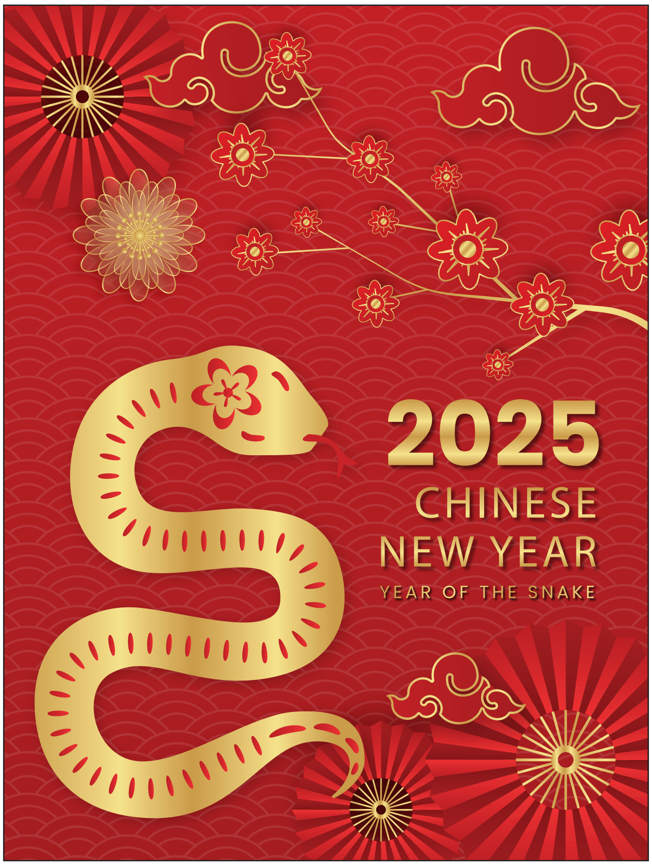

Historic Dockyard Chatham, England

In April 2024, I visited the Dockyard Chatham in Kent. The dockyard is a maritime treasure trove that celebrates Britain's rich naval history. Over 400 years old, the dockyard had played a pivotal role in shipbuilding and the British Royal Navy's dominance of the seas. It is now home to three historic warships.

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The HMS Cavalier is preserved as a memorial to commemorate the 142 Royal Navy destroyers sunk during the Second World War and the loss of over 11,000 lives. HMS Gannet was built on the River Medway at Sheerness Dockyard in 1878 when iron and steam was introduced to warship construction. HM Submarine Ocelot, launched in 1962, was the last warship to be built at the dockyard for the Royal Navy.

The Westland Dragonfly was the first British-built helicopter to serve in the Fleet Air Arm. Chatham is also the only one of the original four Royal Navy Ropeyards to remain in operation and demonstrations of the ancient craft of rope making still takes place here daily. ■

Photography by:
Ir. Ts. Dr Lohgheswary Nagarethinam

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Ir. Prof. Dr Tan Chee Fai
IEM Honorary Secretary

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ELECTRONIC ENGINEERING	
MUHAMAD DUSUKI BIN ZAKARIA	BE HONS (UKM) (COMMUNICATION & COMPUTER ENGINEERING, 2006)
MECHANICAL ENGINEERING	
ABDUL FATAAH BIN A SAMAD	BE HONS (UITM) (MECHANICAL, 2017)

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TEOH JUN SHIN	BE HONS (LEEDS) (CIVIL & STRUCTURAL, 2011) MSc HONS (UITM) (STRUCTURAL ENGINEERING, 2012)
CHEMICAL ENGINEERING	
CHIN JIT KAI	BE HONS (SHEFFIELD) (CHEMICAL, 2001) PhD (SHEFFIELD) (2007)

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ELECTRICAL ENGINEERING		
121661	KOONG GIA ING	BE HONS (UM) (ELECTRICAL, 2013) MSc HONS (USM) (ENGINEERING SCIENCE, 2015)
75345	AMIRUL ASRAF BIN ABD LATIF	BE HONS (UITM) (CIVIL, 2012)
123901	NORFADILAH BINTI ZULKEFLI	BE HONS (UMPSA) (ELECTRICAL & ELECTRONIC, 2012)
64796	TAI CHIA WUEN	BE (UTHM) (ELECTRICAL, 2011) ME HONS (UTHM) (ELECTRICAL, 2013)
CHEMICAL ENGINEERING		
105791	KHOO LYNN HUI	BE HONS (UCSI) (CIVIL, 2017)
112805	ABDUL HASEEB BIN SALLEH	BE HONS (UITM) (CHEMICAL & PROCESS, 2016)
115768	LAK JIA HUI	BE HONS (UTAR) (CHEMICAL, 2020)
MECHANICAL ENGINEERING		
119009	PHILIP TAN SHIEN MING	ME HONS (NOTTINGHAM) (MECHANICAL, 2016)

TRANSFER TO CORPORATE MEMBER

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127536	FAIZULAZHAR BIN MADZLAN	BE HONS (UITM) (CIVIL, 2008) MSc HONS (UITM) (STRUCTURAL ENGINEERING, 2017)
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27088	GAN CHIN HUA	BE HONS (USM) (CIVIL, 2008)
ELECTRICAL ENGINEERING		
46869	MOHD HILMI BIN ABDULLAH	BE HONS (UM) (ELECTRICAL, 1998)
116136	GUAN JUEN NAM	BE HONS (UTAR) (ELECTRICAL & ELECTRONIC, 2018)
MECHANICAL ENGINEERING		
59207	SYAHRUL RAMADHAN BIN AHMAD KAMAL ARIFFIN	BE HONS (UMP) (MECHANICAL, 2013) MSc HONS (UMP) (MECHANICAL, 2022)
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