FEATURE

DEVELOPING ENGINEERING WORKFORCE, DESIGNING A BETTER FUTURE

3rd Ir. CHIAM TEONG TEE MEMORIAL LECTURE, DELIVERED BY ACADEMICIAN DATO' Ir. PROF. DR CHUAH HEAN TEIK

Ir. Dr Ooi Teik Aun

Ir. Dr Wang Hong Kok

The Speaker

Prof. Chuah Hean Teik, Senior Fellow of the Academy of Science, Malaysia, graduated with a B. Eng (First Class Honors) and went on to obtain a MEngSc and Ph. D in electrical engineering from University Malaya. Since April 2008, he has served as the President of Universiti Tunku Abdul Rahman (UTAR) and has authored/co-authored more than 260 papers in international journals and conferences. Academic achievements aside, Prof. Chuah is equally successful in his engineering practice. He was elected as President (2009-2011) of The Institution of Engineers, Malaysia (IEM) and served on the Board of Engineers, Malaysia (BEM) in various capacities. He is also a Council member of Malaysian Engineering Accreditation Council, and a Council member of Malaysian Qualification Agency.

One thing I have learned in a long life: that all our science, measured against reality, is primitive and childlike – and yet is the most precious thing we have. **ALBERT EINSTEIN**

It's not technology changes the world. It's people using technology changes the world. **JACK MA**

Photo session with the speaker

On 23 March, 2019, Auditorium Professor Chin Fung Kee was packed with IEM members who had come to listen to Prof. Ir. Dr Chuah Hean Teik who delivered a 2-hour lecture. Those who turned up included IEM President Ir. David Lai, Past Presidents Dato' Ir. Pang Leong Hoon and Ir. Choo Kok Beng, Vice President Ir. Prof. Jeffery Chieng, Hon. Secretary Ir. Mohd. Khir, Council Members Ir. Yam Teong Sian, Ir. Dr Lee Yun Fook and Ir. Dr Jayaseelan Nadarajah and Past Hon. Secretary Ir. Yap Soon Hoe.

In his lecture, Prof. Chuah shared his thoughts on developing the engineering workforce to include the training of engineers, technologists and technicians. For this article, the authors would use a popular open system model (Mockler, 1968) in Section 2 to highlight the core concepts of the lecture which range from the evolution of digital engineering education and mobility of engineering workforce to other expected "soft traits" of the engineering workforce.

Are engineering education and engineering practitioners facing a big problem? Prof. Chuah certainly thinks so. See Figure 1 on the decline of Science, Technology, Engineering and Mathematics (STEM) enrolment.

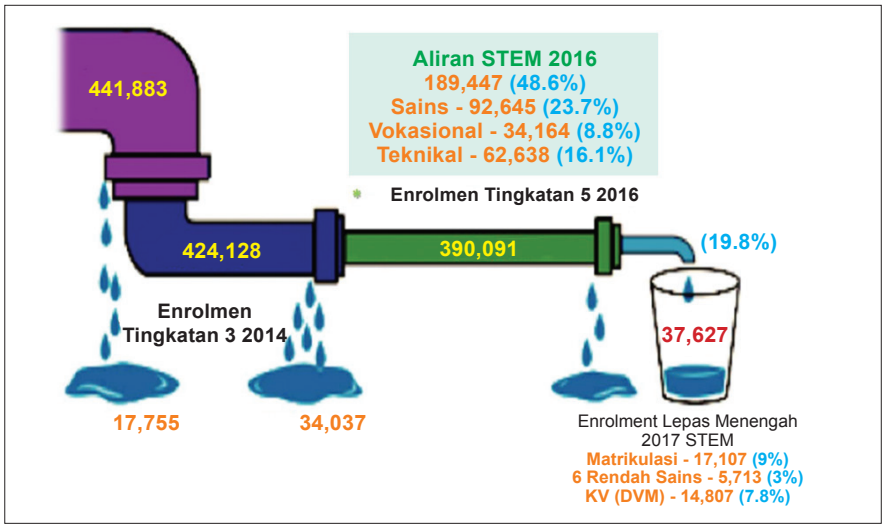

Figure 1: STEM Enrolment
Source: MOE, Malaysia Educational Statistics

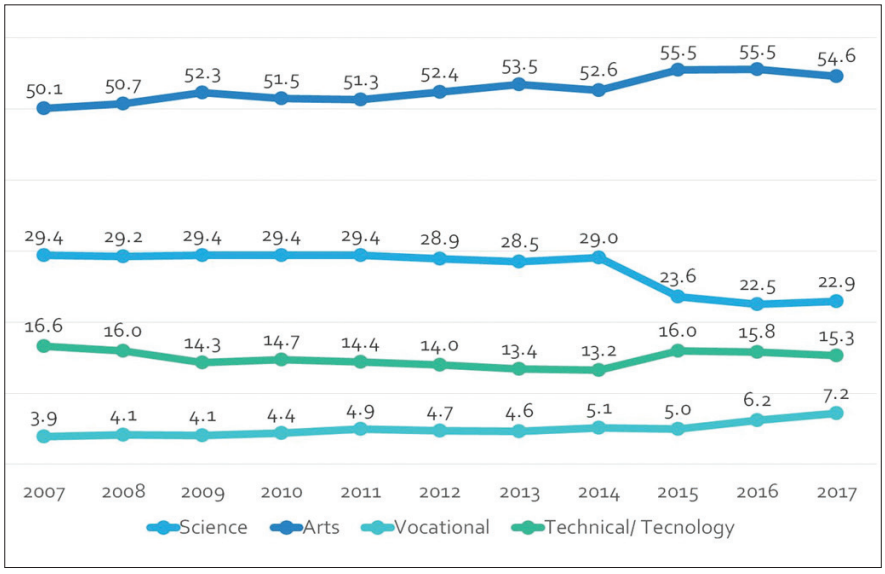

Figure 2: Fewer Students Chose STEM vs Arts
Source: MOE, Malaysia Educational Statistics

IEM members who attended the lecture

Out of 441,883 students who enrolled in Form One in 2012, about 189,447 students (48.6%) entered Science stream in Form Five in 2016. But in 2017, only 19.85%, or a paltry 37,627 students chose STEM in post-secondary schools.

Figure 2 shows a general but definitive decline of STEM among 15-year-old students between 2007 and 2017. For example in 2007, 50.5% of students enrolled in Arts, while 49.9% of students enrolled in STEM. In 2012 the figures were Arts (52.4%) and STEM (47.6%). The figures further declined in 2017 with Arts (54.9%) and STEM (45.1%). The growing lack of interest in STEM education is clearly evident.

Malaysia hopes to produce one engineer for every 100 people. Table 1, however, paints a pathetic ratio of 1:192, a far cry when compared to other Western countries.

Table 1: Engineering-Population Ratio

COUNTRY	ENGINEER-POPULATION RATIO
France	1:75
Germany	1:85
Canada	1:120
United Kingdom	1:141
Malaysia	1:192

Source: MOE, Malaysia Educational Statistics

In the context of globalisation, urbanisation, keen competition, knowledge-based digital economy, new emerging areas and human networking, a deeper appreciation of the role of engineering workers is needed and this is basically the aim of Prof. Chuah's lecture.

From his lecture, we focus on answering two questions in this report. First, what are the challenges facing the engineering workforce in the digital era? Second, what are the issues facing engineering educators?

CHALLENGES FACING THE ENGINEERING WORKFORCE

Basics of an open system. An open system model is actor-centric. The key is to see how the external environment can impact on the decision-making of an entity.

Such a model may be used to explain the current situation of the engineering workforce – Prof. Chuah noted that both the rapidly changing external environment (such as forces of globalisation, urbanisation, keen competition, digital engineering, mobility, etc.) and the stakeholders' influence in decision-making (government bodies, Institutions of Higher Learning (IHL), students, parents, engineering industry, etc.), can contribute to the quality of our engineering workforce.

He believed that we regard the engineering workforce as a collective good/public good. Elinor Ostrom, a Nobel Prize co-winner of Economic Science in 2009, developed her famous model "Institutional Analysis Development" (IAD)

framework to provide further insight into how to govern collective goods/public goods effectively.

Figure 3 shows the popular open system model, adapted from Robbins and Coulter (2012, p. 64). There are four dimensions in the model: Stakeholders as input, decision clusters involving the transformation process, context/environment and quality of engineering workers as output.

Input of stakeholders. The stakeholders are the government bodies, institutions of higher learning, students, parents and the engineering industry. The incentive structure, if done well by government bodies, can encourage more students to enroll in STEM. The prospects of employment too will affect the decision-making of parents and students.

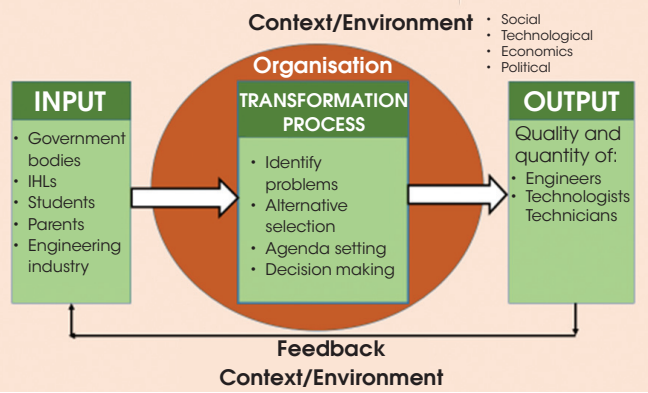

Figure 3: Dynamics of Challenges Facing Engineering Workers
Source: Adapted from Robbins and Coulter (2012, p. 64)

Transformation process. Before enrolling in STEM, students and their parents will have to make a series of decisions.

1. Is the foundation adequately built to undertake STEM?
1. What are the career prospects?
2. What are the challenges awaiting STEM graduates?

To the third question, Prof. Chuah listed seven challenges in the real world: Inequality, pollution, food shortages, energy consumption, global warming and climate change, health & ageing and security (physical space and cyber space).

Context/Environment. This dimension can be classified into four categories: Social, technological, economics and political (STEP) environments.

1. In the social environment, Prof. Chuah said change may happen at a faster pace; he foresees a borderless world and more opportunities of doing business.
2. In the technological environment, citing rapid changes to the past technological revolution waves, he said "technologies are being embedded in societies and even human bodies in a whole new way".
3. In the economic environment, he painted an even worse scenario; in 2016, "the richest 10% adults hold 89% of world assets while the bottom half owned less than 1% of world assets".
4. In the political environment, some countries may not be taking global warming and climate change seriously despite the clear threat to the survival of the human race.

Output of the engineering workforce. Prof. Chuah listed a total of 10 skills expected of our engineering workforce as

highlighted by the British Council (2017): Sense-making, social intelligence, novel & adaptive thinking and cross-cultural competency, etc.

CHALLENGES FACING ENGINEERING EDUCATORS

As we move to develop the engineering workforce of the future, Prof. Chuah reminded us of two issues: The perceived weaknesses and issues facing STEM educators. First, many students viewed STEM as "tough, boring, too technical and hence little fun". Second, STEM educationists have to grapple with a different set of problems such as employability of graduates, equity and access, innovation, financing, quality assurance and governance of education and TVET in the new era.

CONCLUSION

This short report answered the two above-mentioned questions. To recap, first, what are the challenges facing the engineering workforce in the digital era? Second, what are the issues facing engineering educators?

To the first question, armed with the requisite skills, the trained engineering workforce should be able to face challenges in the fields of inequality, pollution, food shortages, energy consumption, global warming and climate change, health & ageing and security (both physical and cyber space). To the second question, to survive the onslaught of a rapidly changing technological era, the answer could be in adopting a flexible attitude while being willing to embrace a life-long learning philosophy.

Before ending his lecture, Prof. Chuah asked what stakeholders can collectively do to strengthen the engineering workforce in order to reverse the trend of declining enrolment. He identified five focus areas:

- Accreditation of programmes offered by IHL should remain a top priority since the standard would be maintained in the process.
- Educators must be able to share their knowledge in the internet era "where complex cross-regional problems" are solved.
- Networking of like-minded professionals can further bring about a higher level of success.
- Our school system should be the budding bed that promotes interest in STEM.
- Engineering stalwarts should consider playing a more effective leadership role that facilitates the students' interest in this field.

Perhaps Winston Churchill's quote can motivate us further: "A pessimist sees the difficulty in every opportunity; an optimist sees the opportunity in every difficulty". ■

REFERENCES

[1] Mockler, R. (1968), The system approach to business organisation and decision making, California Management Review, 11, no. 2, 53-58. http://cmr.berkeley.edu/search/articleDetail.aspx?article=4166, accessed on 30 March 2019.

[2] Ostrom, E. (1990), Governing the commons: The evolution of institutions for collective action, Cambridge University Press, http://wtf.tw/ref/ostrom_1990.pdf, accessed on 30 March 2019.

[3] Robbins, S. S and Coulter, M. (2012), Management, 11th Edition, Pearson, p. 6.

Authors' Biodata

Ir. Dr Ooi Teik Aun *Hon. FiEM, FICE graduated with BE and ME from Auckland University and PhD from Sheffield University. He was Superintendent of Research and Laboratory while in JKR. He is founder Chairman of TUSTD, Organising Chairman WTC2020, Deputy Chairman TUSTD, Director of TAO Consult, Director of IEMTC and IEM Academy.*

Ir. Dr Wang Hong Kok *is the Principal Lecturer of Tunku Abdul Rahman University College since 2014. He is an IEM Council Member, Honorary Treasurer (2016-2018), Founding Chairman of Urban Engineering Development Special Interest Group (UEDSIG), Founding Chairman of Tan Sri Yusuff Final Year Project Competition Committee. He is also a member of IEM JURUTERA Editorial Board.*