Evolving Engineering Education for the Future

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ENGINEERS ARE PROBLEM SOLVERS WHO RISE FROM CHANGES

What is engineering? What do engineers do? These are questions that secondary school students normally ask when enquiring about engineering programmes offered in universities at education fairs or STEM-related activities organised by various NGOs.

In general, engineering is a problem-solving process that connects new needs to new solutions. Answers to the above questions are usually very generic, such as engineers design things and engineers build things or solve daily problems affecting human lives. Figure 1 illustrates this simple relationship in a nutshell.

This rather simple relationship can be further elaborated in a clearer picture where engineers are defined as designers or problem solvers who come up with designs that offer solutions to problems arising from the need to satisfy man's complex needs and desires. This relationship is clearly illustrated in Figure 2.

It should be noted that the needs of society are the source of the problems. Engineers are there to solve these problems by developing new technological solutions.

As time progresses, there will be changes in society and the environment (as well as other factors). Such changes affect all humans and include health care issues, increase in ageing population, global warming and demand for energy, water resources and food.

These changes create needs that are complicated in nature and which demand solutions from engineers. In other words, as explained by Cropley (2015), these changes, which occur over time, will generate new needs and new solutions. This is illustrated in Figure 3, where change is the primary driver for new solutions.

Figure 1: The Basic Process of Engineering

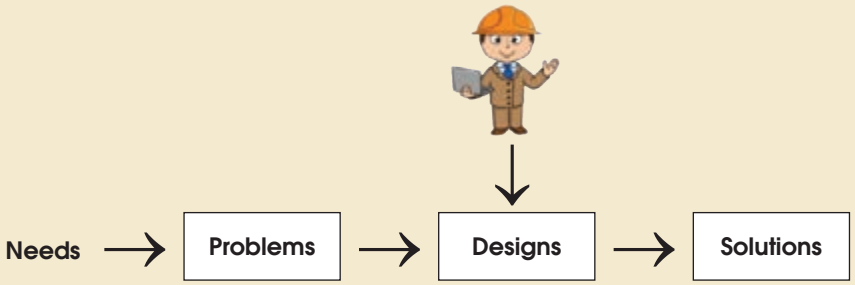

Figure 2: Engineers are needs-driven problem solvers

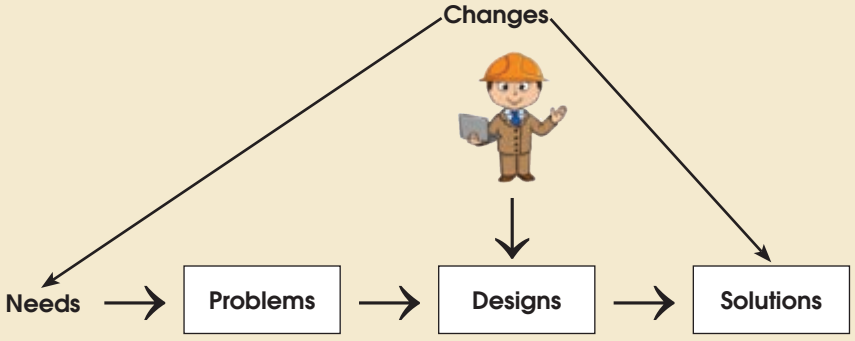

Figure 3: Change as the driver for needs and solutions

SURVIVAL SKILLS IN THE 21ST CENTURY

For centuries, engineers were responsible for a large portion of major technological breakthroughs (Puccio & Cabra, 2010). Now, more than ever, the world needs engineers who are able to solve present and future challenges as well as problems (Twohill, 2012). This is mainly due to the fact that design and problem-solving activities are an integral part of engineering.

In 2006, The Partnership for 21st Century Skills, in collaboration with the Conference Board, Corporate Voices For Working Families and the Society For Human Resource Management, conducted an in-depth study to determine and identify the skills which employers look for today (Casner-Lotto & Benner, 2006). Figure 4 illustrates these skills as listed in the executive summary of the survey.

From the survey, it is clear that applied skills are very important. For the engineering sector, 5 countries and regions had also developed their own national framework/ manual for engineering graduates and employers, where various traits,

Basic Knowledge/Skills	Applied Skills
English Language (spoken)	Critical Thinking/ Problem Solving
Reading Comprehension (in English)	Oral Communication
Writing in English (grammar, spelling, etc.)	Written Communications
Mathematics	Teamwork/Collaboration
Science	Diversity
Government/Economics	Information Technology Application
Humanities/Arts	Leadership
Foreign Languages	Creativity/ Innovation
History/Geography	Lifelong Learning/Self Direction
	Professionalism/Work Ethic
	Ethics/Social Responsibility

Figure 4: List of Skills Necessary for 21st Century (Casner-Lotto & Benner, 2006)

Table 1: Framework/Manual Developed by 5 Countries and Regions

Country/Region	Framework/Manual
USA	Workplace Know-How and ABET Engineering Criteria 2000
United Kingdom	Key Skills and OSC Eng Occupational Standards
Australia	Engineers Attributes
Japan	Employable Personal Qualities
European Union	Generic Employability Skills

attributes, qualities and skills were identified as the required attributes for engineering graduates (*Yuzainee, et al., 2012*). Engineering education providers are now required and expected to produce highly skilled, creative and innovative engineers.

Having evolved from a production-based economy to one that is knowledge-based, Malaysia is definitely in need of a well-designed higher education curriculum that focuses not only on technical skills and knowledge but also on equipping graduates with abilities such as creativity, innovation, leadership and entrepreneurship. This will enable Malaysia to stay upfront, relevant and competitive in the global marketplace (Selvaraj, Anbalagan, & Azlin, 2014).

Apart from this, our engineering education system must not only be sensitive to these changes in the environment and the needs of the society but must also be able to cater to developing/cultivating skills that are critical for the survival of future engineers in the 21st century.

ENGINEERING EDUCATION IN MALAYSIA

It all started in 1956 with the setting up of the Engineering Department at the University of Malaya (then in Singapore). After Malaya gained independence in 1957, the University of Malaya campus was moved to its current location in Kuala Lumpur in 1958. Engineering education achieved another major milestone in 1975 with the upgrading of Universiti Teknologi Malaysia (UTM) from its previous status as a technical college. Ever since then, it has become a major institution for the education and training of engineers in all disciplines.

Over the years, engineering education in Malaysia has undergone tremendous changes to meet professional, technological and industrial needs. Currently the engineering curriculum is tailored to meet the Bloom's Taxonomy as well as the Outcome-Based Education (OBE) without neglecting or overlooking the emphasis on core engineering subjects. These core subjects are the foundation for all engineering programmes and help nurture and enhance the ability of the graduates to identify and solve problems.

Unfortunately, all countries around the world, including Malaysia, are not doing enough to support these 21st century learning skills development such as creativity and innovation (Brand, Hendy, & Harrison, 2015; Robinson, 2013; Terkowsky & Haertel, 2013; Haertel, Terkowsky, & Jahnke, 2012; Daud, Omar, Turiman, & Osman, 2012; Beghetto, 2010; Kazerounian & Foley, 2007). In many cases, new technologies applied in the world of education are simply just reinforcing the old ways of teaching and learning. (Resnick, 2007).

Malaysian engineering graduates are often reported to be as competent as graduates from overseas universities in terms of education and knowledge. However, research shows that local graduates are lacking in skills such as communication and presentation as well as in creative thinking and innovation (Soon & Quek, 2013).

With today's rapid technological advancement, there is a need to constantly review and update undergraduate engineering programmes in Malaysia in order to produce engineers equipped with the necessary skills to survive in the 21st century and who will be able to meet the needs of the future generations without sacrificing the core basic engineering education (Azami, Mohd., Hassan, Norhamidi, & Farah, 2009; Fairuzza, Nazuir, & Wahid, 2011).

CONCLUSION

Employers are looking to hire workers with adequate skills and who are able to cope with the current and future trends, needs and challenges. Engineering education in Malaysia has to constantly evolve and adapt in order to produce graduates who are able to exhibit a greater degree of employability and survival skills in order to secure employment easily. ■

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