# Engineers of the Future




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**Technological innovation is key to prosperity and growth for all nations worldwide. The important driver here is engineering and engineering disciplines are a combination of various principles; engineers create things which are critical to industrial innovation.**

Through the years, we see more diversity in the engineering field where increasingly specialised knowledge and skills are required. Today, an engineer is required to have multi-disciplinary knowledge. The challenge now is how to prepare the engineer of the future to meet this standard.

This article will discuss the restructuring of the current university education system, graduate attributes, promoting of design skills, interdisciplinary competence and contextual competence as well as potential barriers in order to realise the vision of Engineers of 2020 so that future engineers will develop a broader set of competencies associated with the growth of science and technology.

## RESTRUCTURING HIGHER EDUCATION

It is important to have an education system that enhances student potential effectively and productively so that the quality of students will have a positive and greater impact locally and in global industrial development. Research conducted by *Steela et al., (2015)* proposed to have a better industry by transforming the education system to be more competitive and parallel with the rate of growth of industries.

One example mentioned is Sweden where there is good relationship between industries and researchers. The industries there guide university supervisors and students on the type of solutions they want (Chowdhury, B. H. 2000). From this, it may be seen that they have achieved one step up on the development of industrial technology. On top of that, the author concluded that the curriculum of universities needs to be modified to be more realistic, with job-related skills and knowledge. The education system should be exposed to the needs of industries while maintaining fundamental engineering knowledge. This is one way to prepare future engineers to be more competent when it comes to technology.

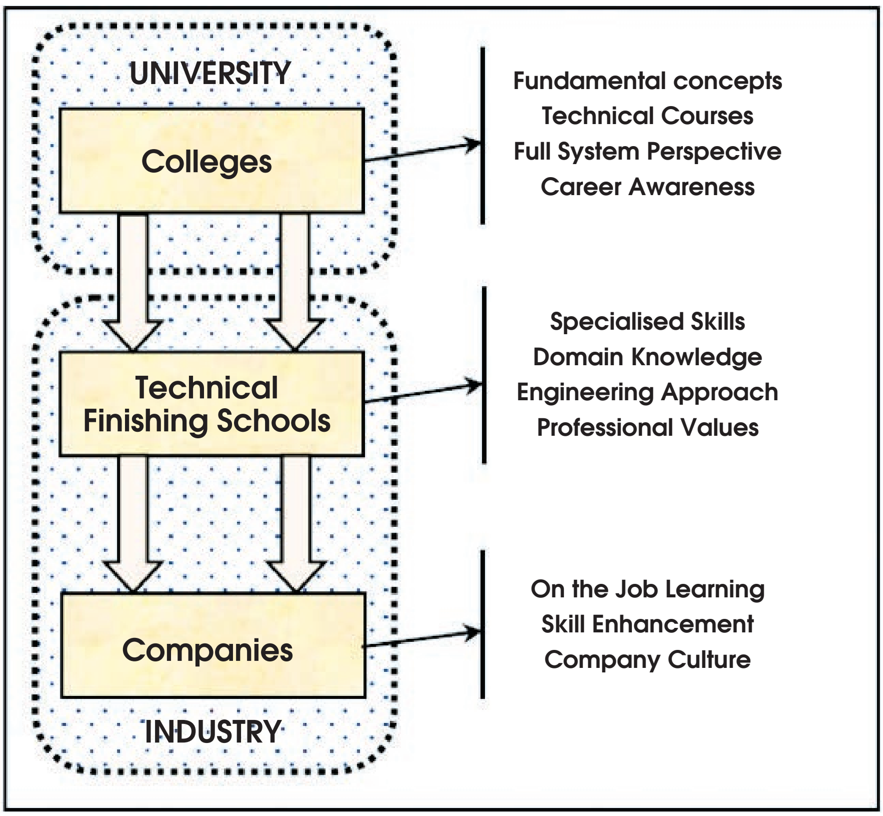


*Figure 1: Industrial Bridge (Deepa, J. 2015)*

Deepa, J. (2015) proposed that education should bridge the industry by introducing technical finishing schools where students will be taught to change their mindset from thinking like a student to thinking like an engineer, to develop their personalities and to learn skills such as business communication, etc. Figure 1 shows the bridge that connects education to industry.

The author stated that feedback at each stage is important in long run. The technical schools should provide suggestions based on the students and companies need to report to the technical schools on areas where students need to improve on so that the next batch of students will be better.

In Malaysia, the technical finishing school is similar to Skim Latihan 1 Malaysia (SLIM) programme which trains students according to services required by companies; trainees will experience actual jobs performed by employees. However, not many companies support the programme and the quota for each batch/intake is limited. It is very important to have good collaboration with all types of industries to be able to produce good engineers in future.

It is very time consuming to want to change the whole education system as one has to take into consideration various factors and processes. However, the proposed method mentioned earlier can be considered as we need high quality engineers in future instead of just greater numbers.

## ATTRIBUTES & VALUES

Rapid development increases the demand for well-educated engineers from diverse backgrounds. Therefore, the challenge is to have competent engineers who can meet the requirements of the market. Parkinson, A. (2009) identified 13 characteristics that a competent engineer should have. These are:

- Respect for other cultures.
- Ability to interact across cultures.
- Knowledge on the history, government and economic structure of various countries.
- Ability to communicate in a second language at a conversational level.
- Ability to communicate in a second language at professional/ technical level.
- Ability to work or direct a team of ethnic/multicultural origins.
- Ability to handle ethical issues pertaining to culture or ethnicity.
- Ability to perceive differences in culture related to product design, manufacture and use.
- Ability to perceive the connectedness of the world and the function of global economy.
- Ability to know the downside of cultural differences on how engineering tasks may be approached.
- Familiarity with international aspects of topics.
- Ability to practise engineering on a global scale.
- Ability to view a person as a "citizen of the world" as well as of a particular company.

*Dias et al.,* (2015) also shared important values that future engineers should learn, such as having a good relationship with co-workers to ensure a project runs smoothly and is completed on time. It is important to clear all doubts within the team so as to have a good relationship and to ensure positive outcome in the project/work.

Apart from that, Rajala, S. A. (2012) concluded that engineers need to have a continuous motivation towards his/her professional role in order to survive in this challenging environment.

Engineers need to have all the basic elements mentioned above and should continue to improve on their knowledge and skills in order to stay competitive and to withstand pressure as industries and technology keep growing at fast rate.

## DESIGN SKILLS, INTERDISCIPLINARY COMPETENCE & CONTEXTUAL COMPETENCE

Apart from the education system and attributes, design is a critical skill required in most engineering fields such as civil, mechanical, biomedical, chemical and aerospace engineering where one must have a strong foundation in technical knowledge and learn problem-solving skills. One also needs to be able to work professionally with clients and customers to design products, processes and give output to complex commercial/public problems.

By providing the design solution, one must take into account the specific context in which the design will be used, depending on the relevant situations including social, cultural, economic, political and environmental purposes. However, the majority of engineering students in universities only work on the report of their designs and problem-solving instead of being involved in co-curricular activities.

The world needs engineers who have disciplinary depth and interdisciplinary breadth. In educating Engineers of 2020, we must restructure design to give a more effective approach to engineering education and practice. This is because engineers of the future must be able to work with disciplines both within and outside the engineering field. This skill set, labelled "interdisciplinary competence", is multidimensional. It is about being able to process and integrate knowledge and skills gained from other disciplines to solve problems.

Being sensitive to engineering problems and solutions in many contexts is required for good engineering practice. It can be defined as "contextual competence" or the ability of an engineer to look at social, cultural, environmental, political and other contexts to mediate the development of optimal engineering solutions. A contextually competent engineer should be able to provide alternative solutions without neglecting context-related needs while evaluating competing technical and contextual assets and liabilities.

The curriculum is an effective way to enhance design skills, interdisciplinary skills and contextual competence. A combination of the problems that students solve in their study, the integration of knowledge and skills from other disciplines as well as the work done within and outside of classroom activities will enhance a student's development of these critical engineering skills.

## POTENTIAL BARRIERS

This part mentioned some of the challenges faced by engineering schools and programmes to realise the vision of *Engineers of 2020*. Few engineering faculties are well prepared to teach and more challenges will arise if the academic institutions prioritise research over teaching and practices.

Many faculty staff members are taking the effort to improve their teaching methods, to provide internship programmes and are calling for industry experts to speak to the students. However, faculty reward-and-incentive systems have resulted in a low focus on the educational mission. Faculties tend to focus more on research than teaching which may hinder lecturers from spending time on extra-curricular activities and projects which can help to better prepare students for their careers in future.

There is a big difference between what engineering education should be and what is actually done in the classroom. Although the engineering faculty may support many of the goals associated with the vision of *Engineers of 2020*, curricular realities lag behind. Engineers of the future should be able to work on interdisciplinary problems and interdisciplinary teams, but the curriculum does not appear to have a similar goal. The engineering faculty is responsible for helping students create the connections among engineering disciplines. However, innovative engineering solutions may require seeking new connections.

The desire for disciplinary interconnections will not affect the undergraduate curriculum. The engineering faculty can help students consider multiple perspectives and find less formal opportunities for students to work with peers from other disciplines.

## CONCLUSION

To be successful, an engineer of the future needs strong analytical skills which are fundamental in engineering practice as well as other attributes such as innovation and creativity, skills in communication, management and leadership, a high level of ethics and professionalism, resilience, flexibility and an understanding of the complex societal, global and professional contexts in which engineering is practised. Thus, Engineers of 2020 will need a new kind of engineering education to develop such a diverse set of interdisciplinary knowledge and skills. ■


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